1654 Vol. XLVI

JULY 20th, 1944

FLIGHT

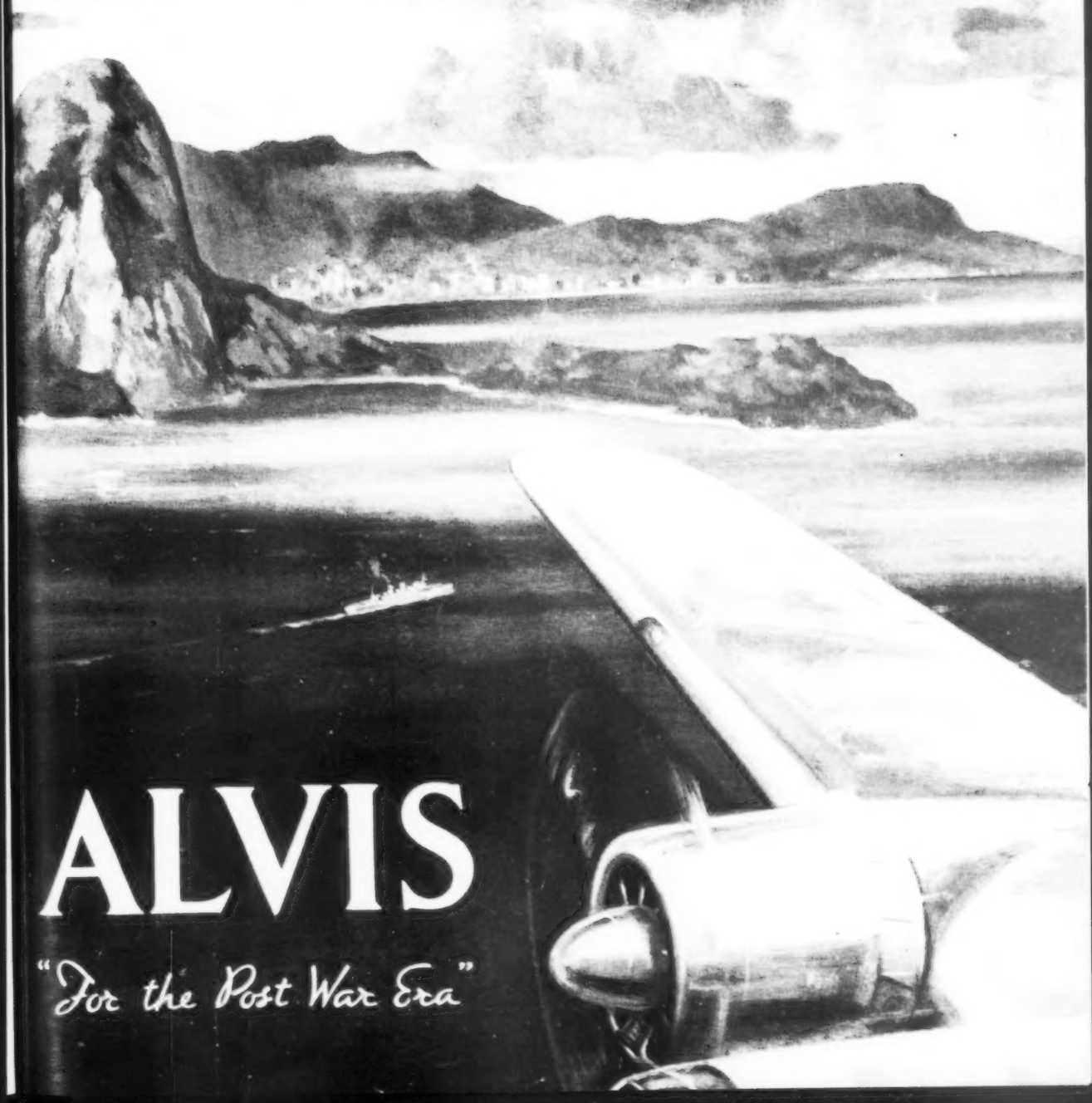
and

AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

ONE SHILLING

RETURN TO "E" LIBRARY



ALVIS

"For the Post War Era"

A LANCASTER OVER NÜREMBURG on the night of March 8th, last year. It was a tough job to get there and it was even tougher over the target! The photograph was taken by means of a flash bomb.

THEY TAKE THE STRAIN IN WAR -

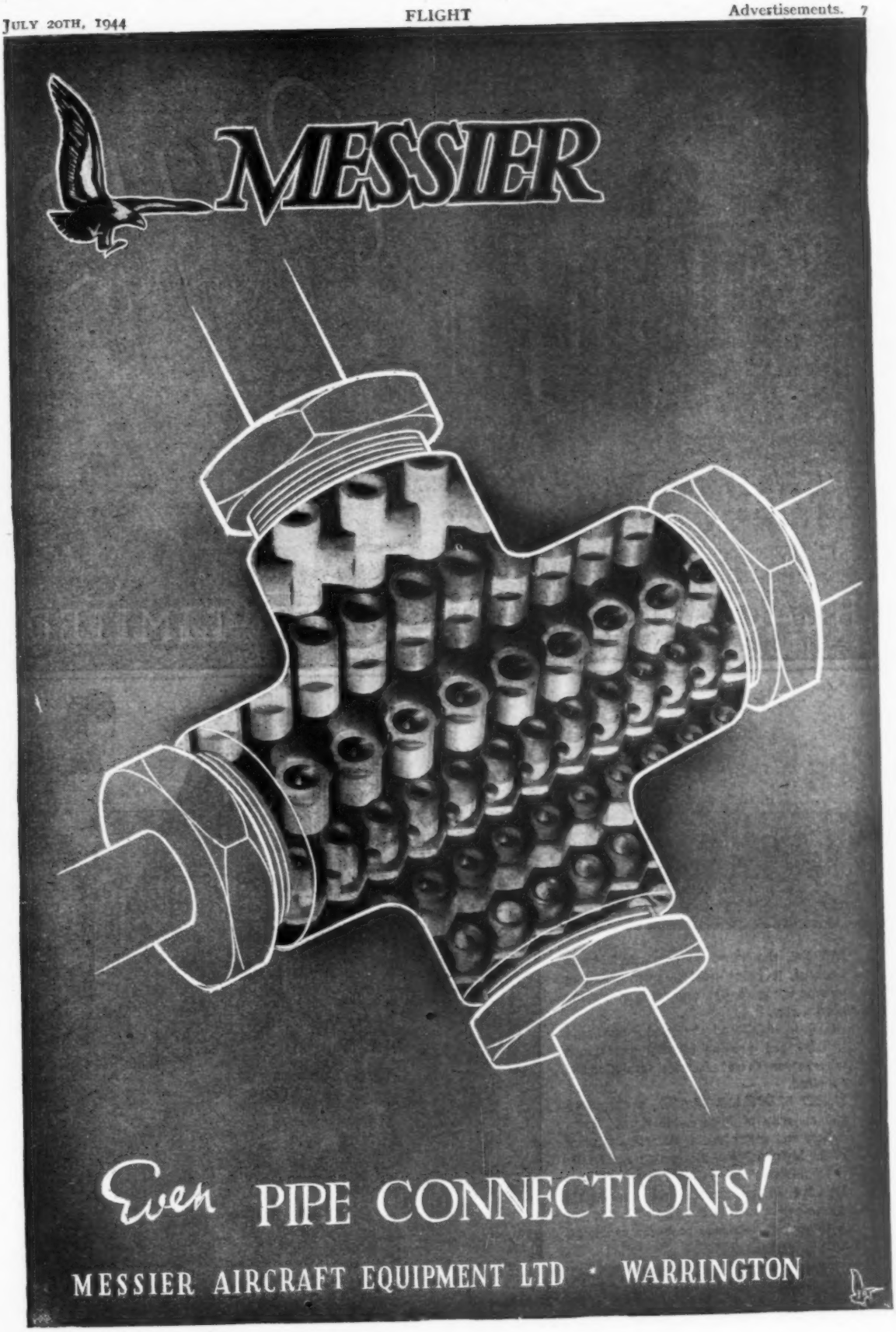
A post-war YORK over Egypt

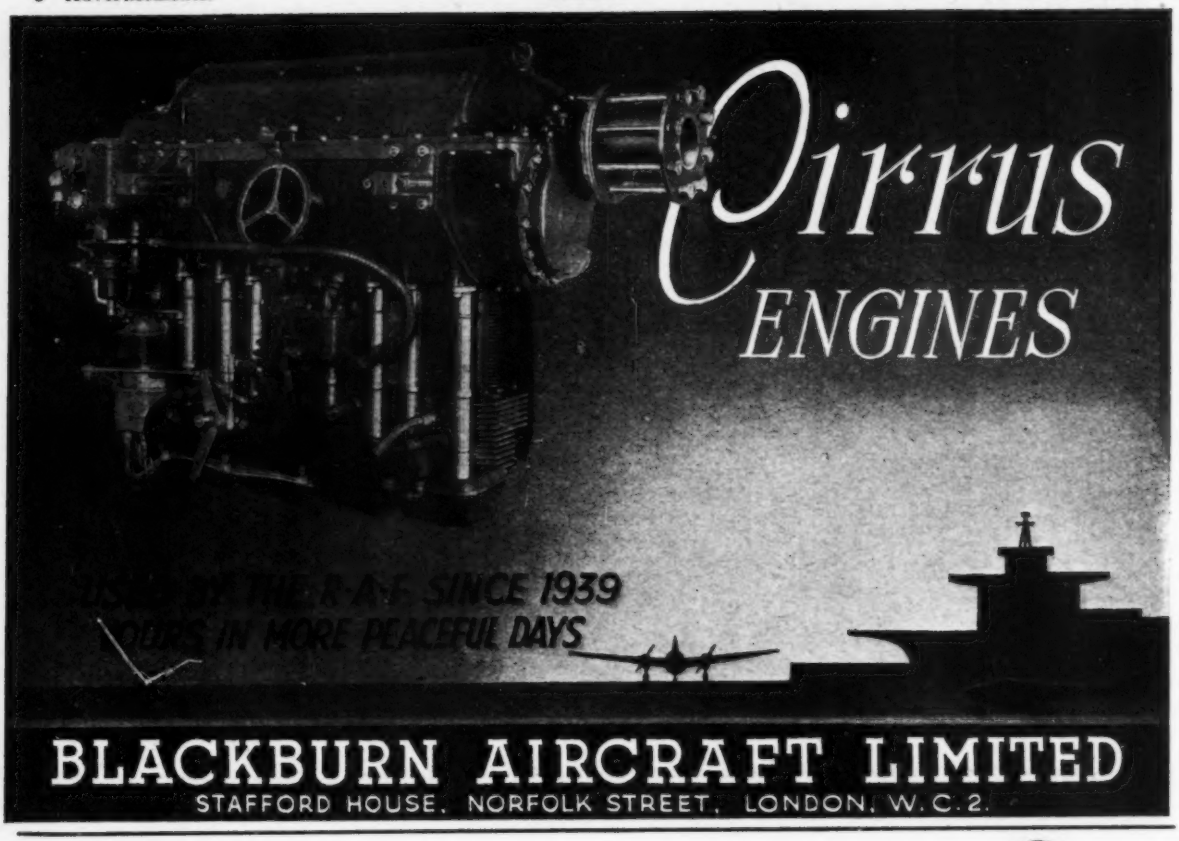
- they'll carry the load in Peace

Superplanes by

AVRO

A. V. ROE & CO. LTD. (*Branch of Hawker Siddeley Aircraft Co., Ltd.*)

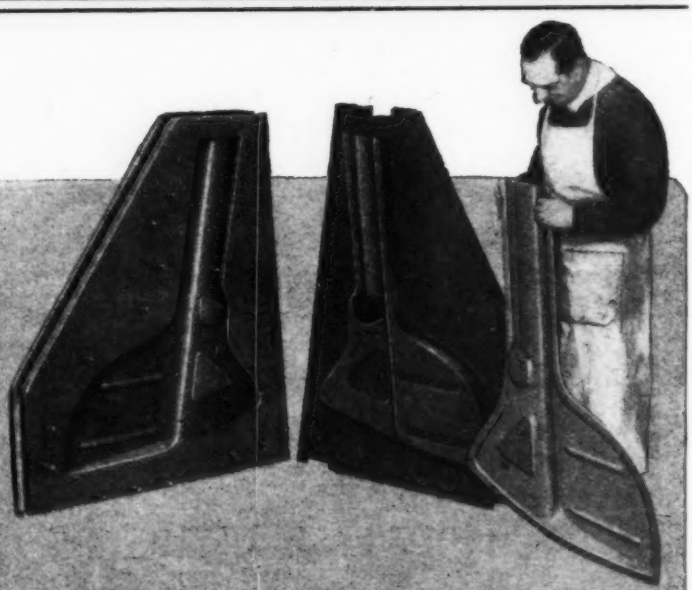

MESSIER
Even PIPE CONNECTIONS!
MESSIER AIRCRAFT EQUIPMENT LTD · WARRINGTON



BLACKBURN AIRCRAFT LIMITED
STAFFORD HOUSE, NORFOLK STREET, LONDON, W.C.2.

BIGGER
and BETTER tools...

JABROC, the improved Laminated Plastic Material, is being used in ever-increasing volume for tools, jigs, templates, stretching blocks, etc.
INSUL-JABROC and fabric and paper based JABLIN are proving of vital importance where strength and electrical insulation are required.
JABLO PROPELLER BLADES as fitted to the majority of Spitfire, Hurricane, Beaufighter and other leading Aircraft are proof of the high quality of this well-known family of Laminated Plastics.
Decades of experience and our highly specialised team of technicians will assist you with your current and post-war problems.



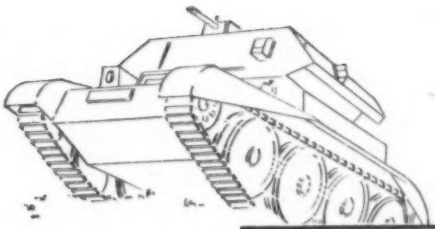
MOULDED COMPONENTS (JABLO) LTD.
The Pioneers of Laminated Plastics
22 OLD QUEEN ST., LONDON, S.W.1

JABROC

GRINDING *the* TOOLS

PRODUCTION FOR VICTORY

THAT WILL FINISH THE JOB.....



Leytonstone JIG & TOOL Co. Ltd.

606 HIGH ROAD, LEYTON, LONDON, E.10. PHONE: LEYTONSTONE 5022-3 GRAMS: LEYTOOL, LEYSTONE

Specialists in

JIGS & FIXTURES

PRESS TOOLS

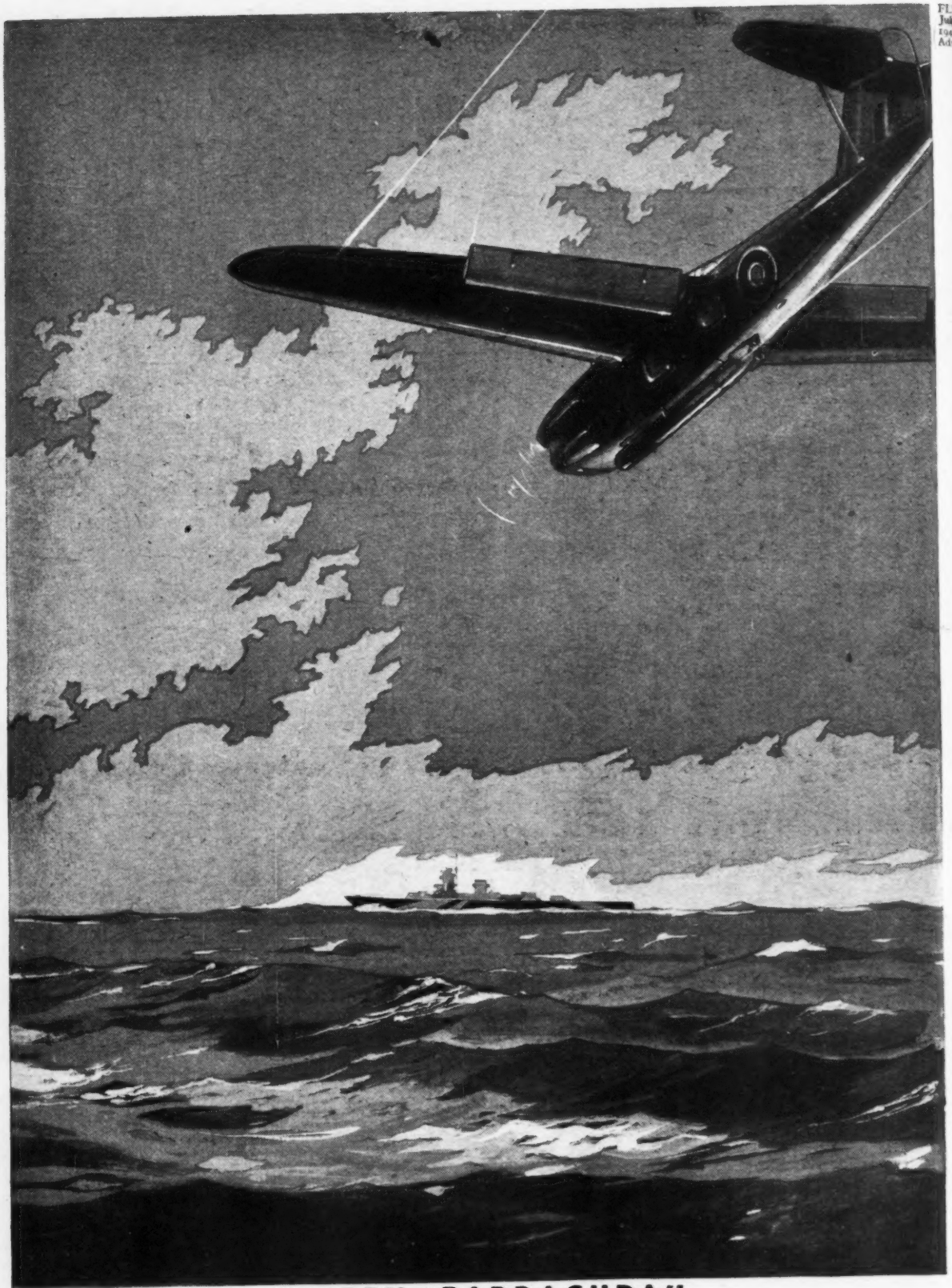
AIRCRAFT ASSEMBLY JIGS & REFERENCE GAUGES

CAPSTAN LATHE WORK

HEAT TREATMENT

SMALL ASSEMBLY HAND TOOLS

FULLY A.I.D. APPROVED



FAIREY "BARRACUDA"

(Rolls Royce "Merlin" engine)

FLIGHT
and
AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

Editor
C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH, M.B.E.

Chief Photographer
JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

COVENTRY: 8-10, CORPORATION ST. Telegrams: Autocar, Coventry. Telephone: Coventry 5210.
BIRMINGHAM, 2: GUILDHALL BUILDINGS, NAVIGATION ST. Telegrams: Autopress, Birmingham. Telephone: Midland 2971 (5 lines).
MANCHESTER, 3: 260, DEANSGATE. Telegrams: Iliffe, Manchester. Telephone: Blackfriars 4412.
GLASGOW, C.2: 26B, RENFIELD ST. Telegrams: Iliffe, Glasgow. Telephone: Central 4857.

Registered at the G.P.O. as a Newspaper.

No. 1856. Vol. XLVI. July 20th, 1944 Thursdays, One Shilling.

The Outlook

From the Horse's Mouth

MANY months ago General Eaker, then still in Great Britain, told a Press conference that the lessons of the campaign in Libya were being carefully studied, and that the most interesting lesson concerned the Tactical Air Force.

Since then a Second Tactical Air Force has been formed by the R.A.F. in Britain, and it, combined with the U.S. Ninth Air Force, now composes the Allied Expeditionary Air Force commanded by Air Chief Marshal Sir Trafford Leigh-Mallory.

It must be admitted with much regret, and perhaps with some feeling of shame, that in the inter-war years only a minimum amount of study was given by either the War Office or the Air Ministry to the proper use of air power in conjunction with Army operations. The subject really would be better described as the employment of air power by the Army. The ground troops and air troops are under different Ministries, and at one time it appeared to the onlooker that they were trying to fight separate campaigns; but if this was so, it was ended during the visit of Mr. Churchill, as Minister of Defence, to the Middle East, when he laid it down that the Air commanders must use their best energies to carry out the wishes of the Army commanders, even if that mean disregarding some tempting targets.

It is typical of the British mind, especially in warlike matters, that it starts its considerations late; but when it has started them it races ahead of the mind of the enemy. The Germans, on the other hand, start considering and forming doctrines well before the event, but show a fortunate (for us) inability to modify their doctrines as the situation develops. A German officer, Freiherr von Imhorn, broadcasting from Berlin last week, declared that the British and Americans have adopted an utterly new strategy in their invasion of Europe. It represents, he said, a complete breakaway from all traditional forms by which wars have been waged. Previously the German High Command had been able to deploy and send up reinforcements on relatively secure supply lines, but in Normandy all military rules and laws of the past had gone by the board. The German fighting men were exposed to the peril of being cut off from their supplies, isolated, and thus destroyed. This, he said, was due to the unprecedented air attack (helped by the fire of artillery and the guns of the ships) on the communications in the German rear. The Germans could not use the highways and railways on which they had counted; and marching columns were banned from the roads.

This is a picture which observers in Allied countries have been able to draw for themselves from the reports sent from the front; but it is extremely interesting to learn from an enemy source that the German High Command is not only embarrassed by our air operations, but is also confounded by the novelty of the British and American tactics.

Air and Sea in the Baltic

THE sweeping Russian advance towards the Baltic republics looks as if it may soon bring about an interesting and rather novel situation in the inland sea to the north. It seems scarcely possible that the Germans will be able to extricate their armies in that part of the world by land. They have left things too late for that.

The alternative is a withdrawal by sea, something on the lines of the Dunkerque evacuation. This movement, if it takes place, will be very different from the original Dunkerque evacuation in a very important respect. The

B.E.F. was extricated from the French beaches because Britain held undisputed command of the sea, combined with a less complete but still invaluable superiority in the air. The *Luftwaffe* was then powerful in numbers, but Fighter Command beat it in quality.

In the Baltic the Russians have an air superiority, for the *Luftwaffe's* might has waned since 1940, but the Germans are superior on the surface of the sea. All the German fleet, with the exception of the crippled *Tirpitz*, is in the Baltic, and it includes the pocket battleships *Admiral Scheer* and *Lutzow*, the cruisers *Hipper* and *Prinz Eugen*, and the carrier *Graf Zeppelin*, though it is very doubtful whether the last-named is operational in the sense of being able to afford air cover to the rest of the fleet. Germany rules the Baltic.

One may, however, feel sure that large numbers of Red aircraft would do their best to interfere with any attempted evacuation of the German divisions by water, and they would not be likely to meet with much opposition except from the *flak* guns of the ships. No precisely similar situation has yet arisen in this war. In the action off Malaya, the Japanese were only concerned to sink two British capital ships, which is a different matter from attempting the destruction of a whole army.

Night and Day

FOR a long time past everyone has come to think of day-bombing as the invariable practice of the American Army Air Forces, while R.A.F. Bomber Command used to abjure daylight with all the disapprobation once expressed by a certain Astronomer Royal.

Conditions in northern France of late have led to some change in this sharp division of lightness and dark. The heavy aircraft of Bomber Command have been called upon more than once to fly over Normandy by day and drop their weighty bombs on concentrations of German armour and other enemy troops. The almost complete elimination of the *Luftwaffe* from the area of the battlefield made this use of Lancasters and Halifaxes by day a fairly safe proceeding; though surprise has been expressed in these columns at the use of bombs when the target was within range of shells. It was certainly not because the Royal Artillery is not up to its work; German prisoners have testified that British shellfire is something too awful for words.

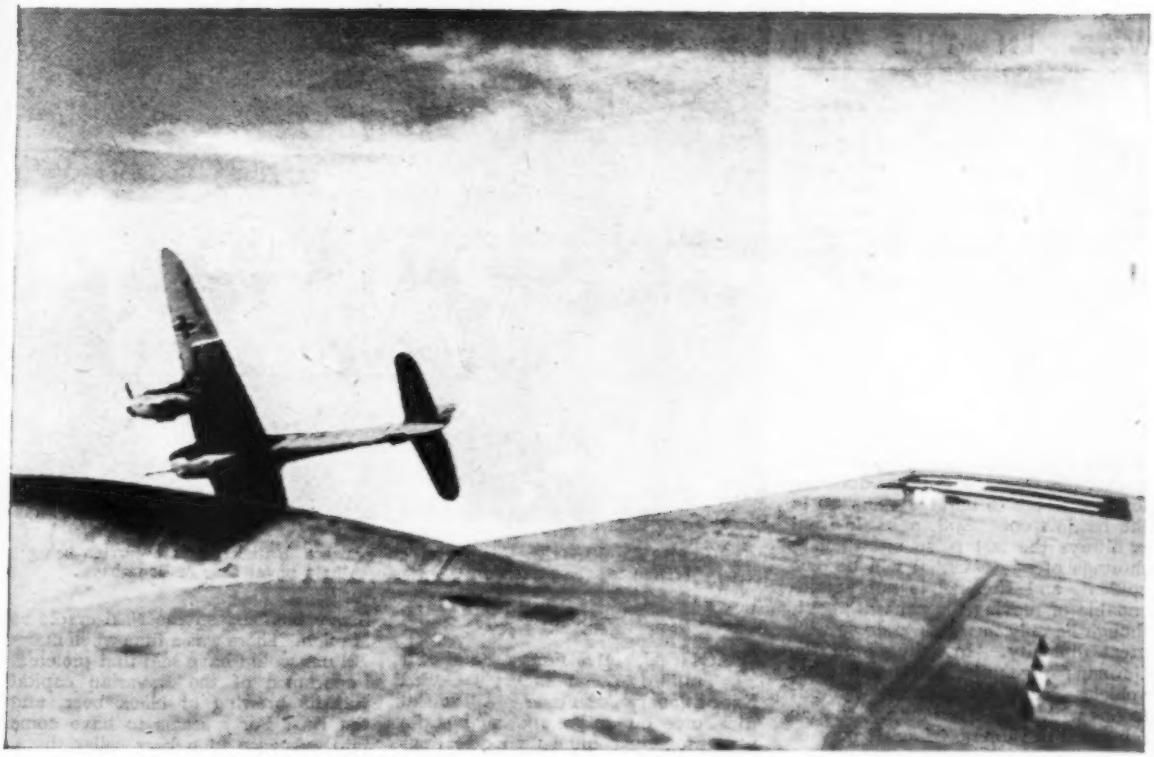
They have also been despatched against the bases and stores, which are officially called "military installations." These targets are outside artillery range, and they have to be attacked by day. The best medicine for them is the 12,000 lb. bomb, and only the British heavies can transport that weapon.

Now, on the other hand, Marauders and other American mediums are being used by night. The enemy dares not move by day, and so the Americans of the Ninth Air Force were short of targets. A change over to night operations became necessary if the Marauders were to continue the work which they have so finely begun. The learning of the new technique is not so difficult for the crews of mediums as for those of Fortresses and Liberators, and those grand aircraft continue their long-range day raids.

CONTENTS

The Outlook	55
War in the Air	57
Here and There	60
Invasion Close-up	62
Topics of the Day	65
Six Months of U.S.S.T.A.F. Operations	66
Aircraft in Flying Attitudes	66, *a* and *b*
Fire Risk in Aircraft	67
Behind the Lines	70
Fighting An Implacable Foe	71
Rotol Cabin Supercharger	72
Post-war Private Aircraft	73
Budd Conestoga	74
Correspondence	76
Service Aviation	77

THE NAVY IN INDIA: Fleet Air Arm rating re-arming a Fairey Barracuda torpedo-bomber at an Indian Ocean station.



FRONT GUNNER'S GIFT : A ME 410 turns away after attacking a U.S. Fortress over Brux. It appears to have a 37 mm. cannon under the fuselage.

WAR in the AIR

The Oil Offensive : Rommel's Difficulties in Normandy : Munich and Berlin Repeatedly Bombed : The Pacific Situation

TACTICALLY the main interest of late has been the unrelenting air attacks on the communications behind the German rear in northern France. Strategically, apart from the wonderful successes of the Russians, the main feature has been the Allied air attack on the enemy's oil supplies in all quarters of Hitler's European fortress.

In the history of the air war since 1939 the estimated importance of oil as a target has jumped up and down like the saw-backed temperature chart of a fever patient. At times there have been concentrated attacks on synthetic plants, refineries, and storage tanks, and authorities have proclaimed that this fluid was the Achilles' heel of Germany and they were aiming at it with the highest expectations. Then, apparently, hopes of producing much effect by these tactics began to fade, and oil disappeared from the headlines. German heavy industries took its place. But every now and again oil would bob up again as a major target for a time.

Now, however, in what is clearly the beginning of the last phase of the war with Germany, the British and American authorities have evidently made up their minds quite definitely that it is time to put forth a great effort to cut off the Germans' supplies of oil. The decision seems to date from the series of attacks on Ploesti. One-third of all the enemy's supplies of refined oil came from that part of Rumania.

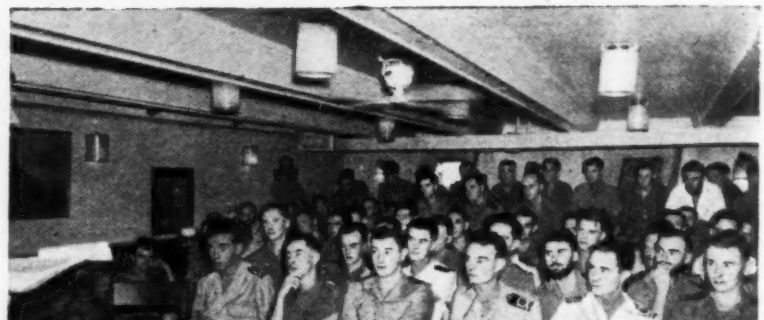
Uncamouflaged Marauders of the French Air Force operating over Italian front.

WAR IN THE AIR

and for a long time the area was out of the convenient range of Allied heavy bombers. The changed position in the Mediterranean has altered that. Only one of the Ploesti refineries is still working, and that may have been damaged. In addition, the principal refineries in Germany, Austria, Hungary, and Yugoslavia have been bombed.

Another third of the enemy's supply came from synthetic plants, and th[illegible]teen of these have been damaged.

As a result, there are definite signs that the Germans are short of motor fuel in Normandy. This will be partly due to the dislocation of their communications, for there may be oil stores not far off, from which it has not been found possible to move tankers up to the battle front. Still, a battle front is always the last place on which a shortage of any essential will become evident, and Rommel is not yet incapable of moving his panzers about, though he only manages to do so with great difficulty. In spite of all the Germans' ingenuity, tanks and other vehicles have been found by our troops with their tanks empty, though otherwise in running trim. It may be deduced from that that their crews hoped up to the last minute that tankers would get up to them, but finally had to retreat hastily before the advance of the Allied troops without having been able to destroy the tanks. When one reads that medium bombers of the 2nd Tactical Air Force destroyed more than 60 trains in the course of four nights last week, one understands something of the difficulties which Rommel has to face.



SOURABAYA SORTIE: Air crews on board a British aircraft carrier being briefed for the attack on the Japanese-held naval base at Sourabaya.

Munich

TACTICAL Air Forces (and Sir Trafford Leigh-Mallory's Allied Expeditionary Air Force is a Tactical Air Force on an international scale) very properly confine their attentions to the battle which is going on under their noses; though they do not consider attacks on the launching sites of the air torpedoes outside their province. The strategical bombing has, as stated above, been mainly concerned with the life-blood of internal combustion engines. None the less, the industrial cities of Germany have not been given a rest. A whole succession of attacks, day after day, has been made by strong bodies of American heavy bombers on the Nazi cradle at Munich. There was a time when many Britons would have said that the chief importance of the Bavarian capital was its brewing of black beer, and the Nazi Party seems to have come into existence in a beer cellar there. The city's adoption of more militant industries has brought upon it many bolts from the blue, and the famous beer cellar is said to have passed into the limbo of things unworthy to survive. Many will hope that the black beer has not also disappeared for good and all.

MORE TO BE PITTED: An installation in the Pas de Calais after attention by Bomber Command using really heavy bombs.

Berlin

NOR has Berlin, the capital of Prussia and of the Reich, had a period of rest while oil refineries were bearing the brunt of the Allied wrath. Heavy bombers did not go there for quite a considerable time, but Mosquitoes paid it frequent visits. As these speedy bombers carried 4,000 lb. bombs, the Berliners probably looked on them as no great alleviation, and the defences of the city had not the satisfaction of bringing many of them down.

It is doubtless useful to keep the sirens of a city sounding night after night, and the Mosquito raids on Berlin served that purpose. Sleepy workers do not produce the maximum output. *Flight* has never put much trust in the theory that the war could be shortened by shaking the *moral* of the German civilians. The reports which neutrals bring out from Germany tell of a sort of hopeless lethargy on the part of the civilians; not of any demand that Hitler should end their sufferings by unconditional surrender. Himmler and the Gestapo would treat any such manifestations in a way which most people would rank as worse than the sound of the sirens

WAR IN THE AIR

and the chance of encountering a 4,000 lb. bomb.

But one of the main concerns of the United Nations is to look ahead and consider the best ways of preventing the German people from starting to prepare for a third world war the moment that the second one is over. Military occupation cannot last for ever, and the best hope for the future seems to lie in persuading the Germans that aggressive war does not pay. Germany surrendered in 1918 before Berlin had heard the sound of a hostile bomb or gun, and it never was occupied by the troops of the Allies. Consequently, the Berliners and other Germans easily swallowed Göring's assurances that they never would be bombed. Their experiences in the present war are not likely to make them demand unconditional surrender now; but they may well have a good effect in the future in making German women, in particular, shrink from the prospect of provoking another war with Britain and the United States—to say nothing of a resurrected France.

The Air Torpedoes

DESPITE the cloudy weather of late, which has been all in favour of the air torpedoes, numbers of them have been shot down. It is on record that no less than five fighter pilots have performed the "hat trick" by shooting down three of them on a single patrol. One Dutch pilot in the R.A.F. has destroyed 12 and a Belgian pilot has bagged 10. The latter, who had also shot up a dozen enemy locomotives, was awarded a bar to his D.F.C.

Shooting down these pests in the air must be quite good fun for a fighter pilot. There is no combat, of course, and the torpedo cannot take evasive action; but each successful shoot may well save lives in the South of England, and pilots who have relations in that area must feel especial satisfaction in seeing an air torpedo fall into the sea or into open country.

But it is always better to destroy wasps in the nest rather than on the wing, and last week a strong force of Lancasters and Halifaxes was sent against another store which the indefatigable reconnaissance pilots had discovered at Nucourt, some 25 miles to the north-west of Paris. The store was in caves in the chalk, and there the torpedoes were sent from Germany to be got into flying trim before being despatched up to the launching platforms. U.S. bombers had already attacked this store, but destruction necessitated the heavier bombs which only the British big bombers can carry. The attack lasted only 18 minutes, but the heavy bombs evidently penetrated through the chalk into the store, for pilots saw two very big explosions. If any Germans were in the caves at the time, their funeral is not likely to cause much trouble.

One reads that the Allies' bombing of railways has caused a somewhat acute shortage of food in Paris. If food cannot be brought in, it must follow that there are considerable difficulties in getting the air torpedoes out and up to the launching platforms. The fact that London had five successive nights last week without any "incidents" shows that this vaunted weapon is falling far short of what the German had hoped of it.

At the week-end there was an improvement of the weather in the Straits of Dover and in Normandy. Such a change naturally gave increased chances to fighters and A.A. gunners to deal with the air torpedoes. It also allowed the A.E.A.F. to give more help to the Army in France.

The most recent addition to the forms of help given by the R.A.F. has been the adaptation of the Hawker Typhoon so that it can carry one 1,000 lb. bomb under each wing. The Typhoon first made its name as a low-altitude fighter, when it put a stop to the daily tip-and-run raids of German fighter-bombers on the towns of the South Coast of England. Now, armed with two such formidable explosives, it is likely to become highly unpopular with the German ground troops who are stubbornly trying to hold up the advance of Gen. Montgomery's men.

NORMANDY HUB: Sir Archibald Sinclair, Air Chief Marshal Sir Charles Portal and Air Vice-Marshal H. Broadhurst in an operations room in France.

IMPORTANT VISITOR: Air Marshal Sir Arthur Coningham, who commands the 2nd Tactical Air Force, in a Spitfire during a recent visit to a 9th A.F. Bomber station in Normandy.

HERE AND THERE

BEACH BUNGALOW: Men in the Services have the knack of making themselves as comfortable as circumstances permit. This Signals unit of a Beach Squadron has dug itself in fairly snugly. Note the small barrage balloons.

Change of Name

HALL & PICKLES, LTD., announce that they have changed the name of their tungsten carbide from H.P.S.A. to Hydraloy.

F. G. Miles Honoured

MR. F. G. MILES, chairman and designer of Miles Aircraft, Ltd., has been elected a Freeman of the City of London and a member of the Worshipful Company of Coachmakers and Coach Harnessmakers.

Changes at Hey's

MR. GEORGE HEY, M.I.Mech.E., has retired from The Hey Engineering Co., Ltd., Coventry. Mr. S. B. Wright, M.I.P.E., has been appointed Managing Director, and Mrs. O. M. Simpson remains Director and Secretary. Both have been with the company since its inception.

Merlin-engined Skymasters

THE fifty Douglas DC-4 transports which Canadian Vickers, Ltd., Montreal, are to build for T.C.A., will be powered by Rolls-Royce Merlin engines. It seems probable that these engines will be the Packard-built type, and the choice, for airline operation, is significant in view of the greater maintenance economy claimed for American radials.

Extension to Ringway

FOR the purpose of extending Ringway Civil Airport to the south and south-east, Manchester Corporation has bought Oversley Ford Farm, Wilmslow, Cheshire, for £4,300.

At present the land is crossed by a highroad (Wilmslow-Hale), and if the extensions are required for landing area or runways, a new road will then be needed.

Blackpool's Bid

BLACKPOOL has now added itself to the increasing number of places anxious to provide Trans-atlantic terminal airports for after the war.

Their scheme, recently considered by the town council, is a £10,000,000 project for a landplane airfield "likely to be the largest in the country" connected by underground tunnel with a seaplane base four miles across, situated at the mouth of the River Ribble.

A private party has offered to put up £2,000,000 towards financing the scheme.

Not So Novel

APART from its jet-propulsion unit, there is nothing very new about the flying bomb. A similar weapon, but driven by normal airscrew, was evolved in the U.S. early in 1918, the idea being to launch them at Berlin from the Allied lines. They had a 400 miles range and a 1,000 lb. charge of T.N.T.

The experiments were carried out at Bellport, Long Island, with five gyro-directed planes, and work was being carried out on radio control when the arrival of the armistice caused the project to be abandoned.

Gen. Mitchell described, in 1922, some trials with a remotely controlled air torpedo 39ft. long, which successfully hit a small target over 60 miles away, the motive power being a normal petrol engine and airscrew.

CARRIER CLOSE-UP: Taken aboard an Allied aircraft carrier during operations against Sourabaya naval base, this photograph clearly shows the bomb bay and wing-folding layout of a Grumman Avenger torpedo-bomber.

Air Comdre. Boothman's New Post

UNTIL quite recently A.O.C. Photographic Reconnaissance Group, Coastal Command, R.A.F., Air. Comdre. J. N. Boothman, C.B., D.F.C., A.F.C., has been appointed to command the Aeroplane and Armament Experimental Establishment.

Now 43 years of age, John Boothman won the Schneider Trophy in 1931 over the Solent. No other country competed

HERE AND THERE

and so it was a "fly-over" for Britain, only Boothman's machine being sent up to cover the course. As this was the third successive win by Britain, the trophy was won outright.

Despite his age, Air Comdre. Boothman has regularly been flying operationally and photographed enemy movements from high above the invasion beaches on "D" Day.

He is, in fact, one of the oldest R.A.F. officers to engage in solo high-altitude flying against the enemy.

Models on Show

AN exhibition of various types of model aircraft is to open in the Piccadilly showrooms of the Bristol Aeroplane Co. on Sunday, July 23rd, and will remain there for a fortnight—until August 5th.

It is being arranged by the Society of Model Aeronautical Engineers, and will include flying scale models (including petrol-driven ones), solid scale, duration, "Wakefield" and sailplane models, together with cups which are to be presented for the best entries in each section.

Scottish Ambition

"THE fight to make Prestwick an international airport is not yet ended," says a Glasgow writer, and he adds, "There are still powerful influences operating in the south who want to prevent Prestwick becoming an international airport."

The same writer quotes Sir Patrick Dollan as saying, "These southerners think that the biggest airport in Britain should be somewhere between London and Brighton or Southampton."

These northerners, apparently, think it should be as far from the British capital as possible.

African Project

WORK has begun on an ambitious scheme to link Africa's Atlantic coast with the Suez Canal by a string of up-to-date airports, says a Reuter message from Cairo.

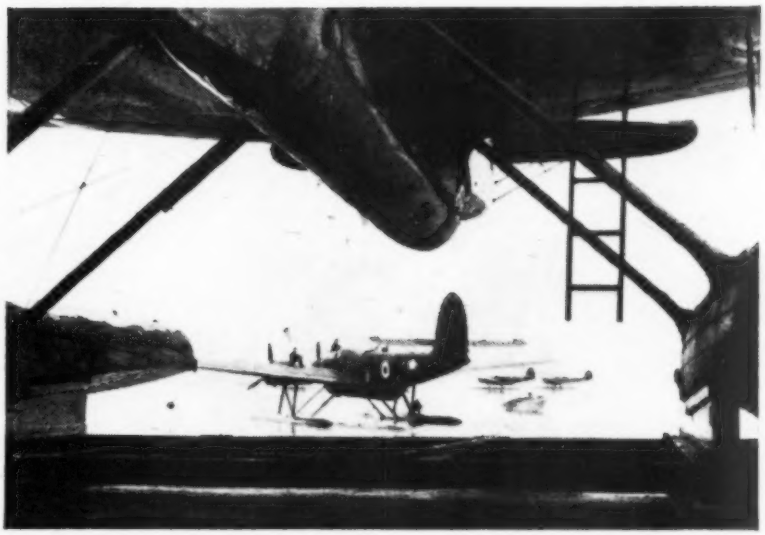
The work is in the hands of South African engineers who have already completed a 2,000-yard runway at the coastal terminal, "near a Moorish city where only Moslems are allowed to enter," and non-European sappers are working on the hangars and other buildings. Four hundred miles to the east work is well advanced on a second similar airport.

Poor Trade

AMERICA'S ace fighter pilot, Lt. Col. Francis E. Gabreski, D.S.C., is quoted by Reuter's special correspondent at "Shaef," Ian Munro, as saying that the Hun pilots will not fight.

"The Germans make one pass and beat it," he said. "They won't stay for any length of time and risk a fight."

Jerry, who generally knows most things on the Allies' secret list, has, we suggest, probably heard the record of Col. Gabreski and his squadron—200 enemy aircraft destroyed, of which the 25-year-old colonel has scrubbed no fewer than 30.



CO-BELLIGERENTS: Aircraft of the *Regia Aeronautica* taken over by the R.A.F. in Italy include a number of Cant 506B three-engined float-planes, some of which are here seen preparing for a convoy patrol. Powered by 770 h.p. Alfa-Romeo radials, they have a top speed of 229 m.p.h.

Keeping in Touch

H. DUNCAN DAVIS, chairman and manager of Brooklands Aviation, Ltd., has always made a point of keeping in touch with as many old flying club members as possible during the war, and he would like to hear from any old members' of Brooklands, Northamptonshire, Cinque Ports and South Coast flying clubs who may care to write to him at Brooklands Aerodrome, Weybridge, Surrey.

"That's young Begley. He's being grounded to-morrow!"

Give It a Name

HAS anyone a really bright idea for naming a new aircraft? If so there is a prize to be won.

As already announced, the de Havilland Aircraft Co., Ltd., is designing a twin-Gipsy-engined all-metal low-wing monoplane for about eight passengers suitable for light transport work until the war finishes, and after that for feeder-line passenger work. But so far they have not managed to hit upon a suitable name for the new type, and will welcome suggestions.

As an encouragement they offer a small prize (probably a *Times* physical atlas and gazetteer) to the sender of the name finally selected.

It may almost amount to "beating the starter," but the writer of these notes herewith suggests the name "Dove." It is eloquent of peace and winged beauty and, what's more, it alliterates magnificently—de Havilland Dove!

Towards Efficiency

"COSTING as an Aid to Production" was the title of a talk given recently by Mr. W. S. Garnham when he was guest speaker at a meeting of the Supervisors' Discussion Group, Enfield Centre, in the technical college at Ponders End.

Mr. Garnham tackled his subject from the essentially practical aspect, and dealt, "not with the mechanics of costing, but with the effect of costing upon mechanics."

Stressing the need for efficiency in British industry to compete with other countries after the war, he wound up his talk by saying that one of the principal aids to this was the proper use of information of which costing was collector, custodian and co-ordinating agent.

D

Invasion Close-up

Air News from the Notebook of Our Correspondent with the Allied Expeditionary Air Forces

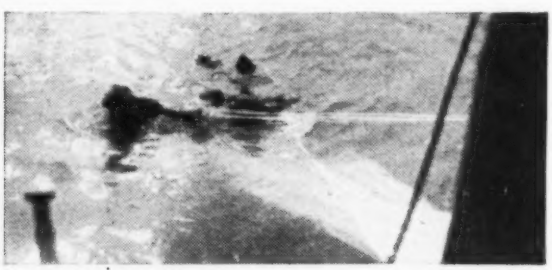
INSTEAD of flying, or visiting air stations last week, I spent a while with an air/sea rescue unit on the South Coast to get their story as to how they had fared on D-Day and thereafter. Just getting in the docks was somewhat of a business. Everyone is suspect, regardless of uniform, and "security" make doubly sure before the necessary pass is issued. One may have a war correspondent's licence and special passes from the Air Ministry; these will avail nothing if no signal has been received notifying your arrival. That is by the way—and just as it should be.

Although there is no flying at this unit, the mark of the Royal Air Force is there just as much as on a big airfield The crews are cheerful masters of a very exacting and tiring job. To be moored out in the Channel in rough water for perhaps 16 hrs. while waiting for a call is far from pleasant, but it is done willingly because the crews know how necessary their work is. A good air/sea rescue service is essential if pilots are to be expected to fight over wide expanses of sea, and from the numbers saved and the stories told it is obvious that an excellent service *is* maintained.

Under the Enemy's Nose

To illustrate the lengths to which they will go to pick up a man, there was one occasion (so a boat skipper told me) on which they went right into the French coast to get a pilot who was standing neck high in the water. Having once got their "customer" they were loath to hand him over to anyone else except the ambulance. There was the case of the height cover Spit IX pilot who was hit by *flak* and had to bale out. An A.S.R. Walrus alighted and picked him up before the boat arrived, but was unable to take off from the heavy seas. The Walrus started taxying home. After some 25 miles taxying the Walrus began to feel tired, and the pilot was put into a rubber dinghy and floated over to the A.S.R. launch. With the casualty on board the launch took the aircraft in tow

A U.S. Lightning pilot in the water with parachute still attached. He had both arms dislocated and could not operate the release mechanism or get into his one-man dinghy.



One of the A.S.R. launch crew goes overboard to help the Lightning pilot in. A crash net is put over the side to enable the rescuer to get a better grip.

For protection, the boats carry a defensive armament of eight machine guns and one 20mm. cannon. In the conning position is the skipper, F/O A. Keating.

and, against a strong westerly wind, did the final 22 miles in six hours. This story was told to me in an almost jocular manner to prove how loath a boat or an aircraft is to hand over a casualty except to the ambulance. Actually, of course, there were great feats of endurance, seamanship and bravery behind it all.

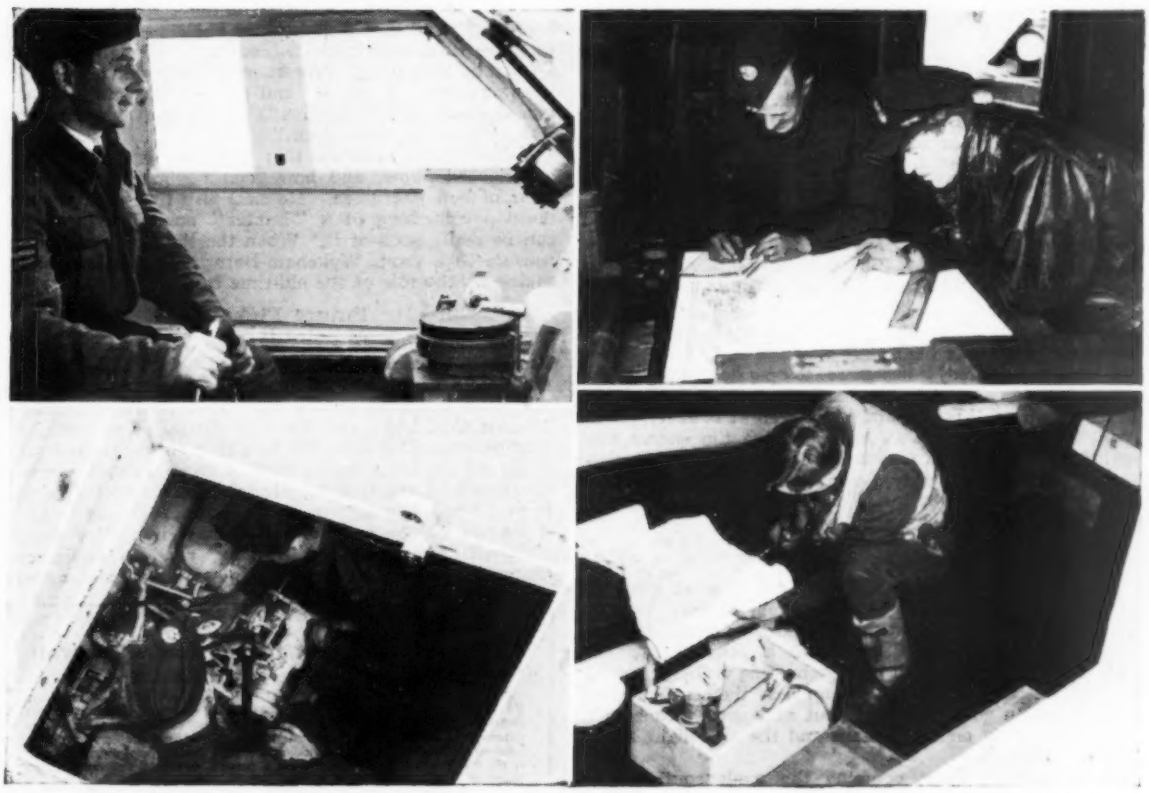
Some of the pilots picked up are incredibly tough. A Thunderbolt pilot was unfortunate enough to have a leg torn off—either by being trapped in the cockpit or by impact with the tail surfaces—when getting out of his machine. On the way down, as he swung from his parachute, he took off his belt and used it as a tourniquet on his leg. When the boat arrived he was still able to tell them quite calmly what had happened. Certainly A.S.R. see the heroic and the seamy side of air warfare.

Signalling Systems

Normally, the crews have 24 hours on duty and 24 hours off. During the daylight hours of their duty spell they take their boat to an appointed mooring and wait there for further signals. These may come from Group H.Q. via the Royal Navy or direct from a naval plotting station. The aircraft in trouble can itself send out a distress signal and other aircraft which have spotted someone in the sea will circle the A.S.R. launch and indicate to the crew the direction in which to search.

The charts used for search are divided into squares and chart readings indicate the approximate position of the casualty. In these high-speed launches a square can be thoroughly searched in good weather in a very short time. If, however, the weather is bad, and the surface of the water badly broken, the search may go on for many hours. One thing is certain—there is no let up while there is the slightest chance of saving life.

The boats on the station I visited are 63ft. high-speed



(Top, left) The flight sergeant 1st coxswain at the wheel. Engine gear telegraphs are on his left and throttle control on his right. (Top, right) The skipper and the 2nd coxswain plotting a course to the search area. (Bottom, left) A peep down the engine hatchway to where the three white-painted Napier Sea Lions give out their 500 h.p. per engine. (Bottom, right) The medical orderly prepares to attend to his patients. He has an extremely responsible job.

INVASION CLOSE-UP

launches built by the Power Boat Co., Ltd. They have triple screws and are powered by three Napier Sea Lion engines, which are an adaptation of the famous Lion aircraft engines which gave the R.A.F. such wonderful service for so many years and won the Schneider Trophy for Britain in 1922 and again in 1927. These engines give 500 h.p. each at 2,500 r.p.m., and at a continuous cruising speed of 1,800 r.p m. the output is 200 h.p. Fuel consumption is 60 gallons per hour of 73 octane petrol.

Last month's seatime average for the launches on the station exceeded 200 hours each, which is a great tribute to their reliability, and the crews say that the boats will stand more than the men that handle them. Eleven men make up the crew. The skipper is commissioned; 1st coxswain is a flight sergeant with a corporal as his second; a sergeant 1st fitter and an aircraftman 2nd fitter look after the engines. Two wireless operators and three deck hands are carried, and to render first aid an experienced nursing orderly looks after the patients.

Mosquito Tactics

At S.H.A.E.F., Grp. Capt. P. G. Wykeham-Barnes, D.S.O., D.F.C., who commands a Mosquito wing, came to tell war correspondents about the work his wing is doing. Their main task is to keep up a continuous night attack on German lines of communication as a complementary effort to that performed by U.S. and British fighter-bombers by day. The German is very quick to adapt himself to altered conditions, and he was prepared to sleep by day and move his transport by night. The "Mossies" are now making it almost impossible for him to move at any time. As a working area they were given from the battle line in Normandy to as far back into Germany as they could reach. Here is Grp. Capt. Wykeham-Barnes' own account of a recent attack on rail movements on the Chartres-Le Mans route with the object of preventing reinforcements coming up. The vulnerable point was at Tours, where the river Loire has to be crossed. Another Mosquito wing, which the Group Captain referred to as "competitors," was to attend to the south-east feeder lines from Germany because the Seine bridges are blown.

"When we got ready for this task, just as we were about to start our programme, which was to send off waves of aircraft all night long, the weather became very poor and thunderstorms massed up in the English Channel; it looked sinister and consequently we weren't very hopeful. I took off about a quarter past one in the middle of a very heavy rainstorm, with lurid lightning playing all over the place in a rather depressing way.

"We are prepared, if necessary, to operate in almost any weather there is. The most important thing is that we never let up on this job, and have been at it every single night since D-Day. We feel if we give the enemy one night's rest, they will rush a lot of stuff through during that night. Consequently, however bad the weather is in England, if we can get to the area and have a reasonable chance of getting back again, we shove on.

Struck by Lightning

"We set sail across the Channel and weather got progressively worse until we got to the French coast. We calculated we had been struck by lightning then, but we couldn't tell. As we came in at the coast, the flashes from the American barrage became visible, creeping around La Haye du Puits. It appears there was a good deal of action going on there, but as I wasn't concerned about it, I went on to Le Mans and the moonlight began to come through.

"We started, then, combing the roads south of Le Mans, but I can't exactly spin you a blood-and-thunder story. Most of the transport had been chased off these routes and there are not such good pickings left. We had a go at what was left. We found what we fondly believed to be a troop train; it was an engine and a lot of box cars coming north, north of Tours and south of Le Mans.

"This engine just sort of appeared as we went along very low—200ft. Between the rainstorms we suddenly saw the line and this engine coming towards us, with a long string of box cars behind it. We quickly pulled a couple of bombs off on it and then wheeled around and shot it up—no, not up, down! and the engine did the usual thing and shot up a lot of steam. It burst in clouds of steam, and came to a stop. We went on, saving our ammunition. (We might have, perhaps, worked a little harder on that target.) Meantime, the weather was still very bad and the chaps were having a rough time.

"The system we adopt is to keep in radio communication all the time. We had some 20 aircraft working on these lines at once; they are all on the same radio channel, so that you can hear someone saying, "I've found something just south of Le Mans—come on over and get it"—and then everybody quickly reorientates himself, and if it is good—something like a couple of petrol trains—everybody will get to work on it at once.

"It is a rough and ready system of performing, but you have got to have something like that. Two or three chaps may do a patrol and see nothing, and the other one or two of the rest may get to some real prize and not be able to cope with it by themselves.

"Well, that just about concluded that trip. We got down as far as this place here (motioning to Brest on the map). It was actually a little further than I meant to go—I don't mind confessing that we got a trifle lost; we only had a view of the ground about once every five minutes.

"Then back we came again, and we had a couple of bombs left, and turned aside in the battle area and dropped them on what looked like a bivouac of German troops in a wood by Coutances. (We know that they bivouac under trees and disperse vehicles and petrol there, and so these bits of wood surrounding roads are always, as far as possible, subject to our attack."

He went on to explain that this work is only for very experienced pilots, and how good navigation keeps one clear of bad *flak* areas. He said also that a pilot must develop something of a "hunter" mentality before he can be really good at it. When the time comes for fluid warfare Grp. Capt. Wykeham-Barnes sees his Mosquitoes taking up the rôle of the old-time cavalry.

Future Fighters

Shall we see big changes before the war in Europe ends? Targets in Germany recently bombed by the U.S. Strategic Air Forces have included jet-engine factories. We have announced the work of Grp. Capt. Whittle and the Gloster Aircraft Co., Ltd., and the Bell Aircraft Corporation of America are advertising the fact that they have a fighter flying which incorporates two of these Whittle engines developed by the General Electric Company of America. It first flew, they say, on October 1st, 1942. It looks as if we are on the edge of big changes in fighter design. This will mean changed training, changed equipment, changed tactics. In fact, it will mean almost a new start.

New Edition.

Gas Turbines and Jet Propulsion for Aircraft

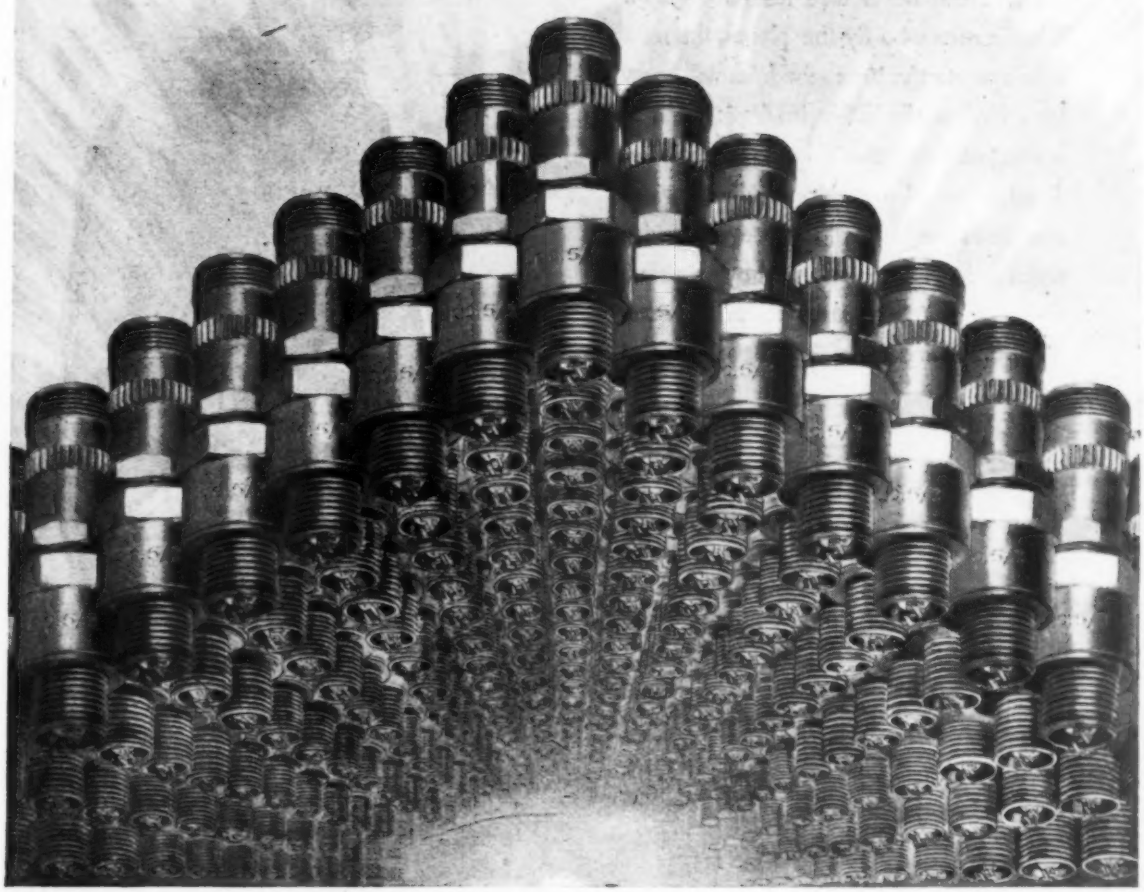
By G. GEOFFREY SMITH, M.B.E.

A THIRD and enlarged edition of this "FLIGHT" book with illustrated descriptions and comments upon the varying forms of steam and gas turbine-compressor units, is now available. Fifteen chapters and many new drawings are included. In this latest edition the original chapters have been retained with modifications and additions. The joint official announcement of the R.A.F. and U.S.A.A.F. has made it possible to extend due credit to the inventive genius and pioneer work of British technicians who developed gas turbine units to a practical stage for aircraft. There is a foreword by Sir Geoffrey de Havilland.

Copies are obtainable through a Bookseller, Price 6/-, or 6/4 by post direct from

Flight Publishing Co. Ltd., Dorset House, Stamford Street, London, S.E.1

Do you know—



That nearly 100,000 Plugs are used for every major bombing operation? That is why you cannot get K.L.G.'s for your own use.

K·L·G

THE 'NO GLAMOUR' BOY

When the post-war airlines encircle the earth *he* won't fly the 'planes. Beautiful damsels will never ask for his autograph. Tourists will never take his photograph. But the men who fly the 'planes, the men who operate the time schedules will know him. He's the Field Service Man. He'll be waiting wherever the 'plane touches down. Ready to refuel, to check and adjust engines and instruments, to do whatever service is needed. When you travel by an airline that uses Field Service expect no incidents. Your only excitement will be the scenery!

FIELD AIRCRAFT SERVICE

A Company of the HUNTING Group • FIELD CONSOLIDATED AIRCRAFT SERVICES LIMITED
LONDON OFFICE: BYRON HOUSE, ST. JAMES'S STREET, S.W.1

C. R. Casson 1

Indicator Discusses Topics of the Day

Making Our Own Future

Honesty is the Best Policy in Civil Aircraft Development : Taking Our Place in the World Markets . Twenty Medium-sized Aircraft for Every "Brabazon?" A Suggested Plan of Campaign

AS it was the custom in our great-grandmother's day to make a virtue of necessity, it is now becoming the custom, so to speak, to make a necessity of virtue. It has been slowly and painfully discovered, in all walks of life, that honesty is the best policy after all. Employers have learnt that it actually pays in hard cash to keep their people happy and comfortable; not to work them too hard, and, in industry as a whole, to make the wages sufficiently high to enable them to buy at least some of the products.

One of these days someone will make the surprising discovery that it pays in the long run not to try and bamboozle the buying public with ridiculous statements about different commodities—statements which, in a great many cases, are patently untrue to all but the wishful thinkers. Most of us—strange though it may seem to some of the more ardent incorporated practitioners of advertising—are much more likely to buy a product for which the failures and inevitable faults are given alongside the points on which it actually scores, and for which the makers do not attempt to make Utopian claims of perfection.

This need for unqualified honesty is going to be very important indeed when the British aircraft industry finally turns to the production of civil aircraft for the world markets. The "advertising," in this case, will be done by the manufacturers' representatives and by the politicians and others who will make world-public claims for types which are in process of development. This "advertising" has already started, and we are asked to visualise formless giants which are due to appear on the air routes in 194? We have even been given certain range and load figures which, in some cases, are already being improved upon by aircraft which are, at the best, only temporary expedients, and for which the manufacturers themselves would be the last to make any claims but that "they were the best that could be produced in present conditions and difficulties.

Military Commercials

Meanwhile, converted military aircraft are crossing the Atlantic in less than the time suggested for a future regular service, carrying a load larger than that tentatively and proudly given for the 194? commercial types, and one new U.S. type has crossed the American Continent, with a very useful payload, at a ground speed far in excess of any of the figures given by our prophets of civil aviation. No doubt it was helped by a good, strong following wind, and an aircraft could not hope to hold that sort of speed as an economical block-to-block figure in ordinary circumstances —but that trans-continental flight was a great deal more impressive to the flying public of different prospective aircraft-buying markets than any statement of hope and faith.

Instead of trying to inspire false hopes, let us admit that, just as they were ahead of us in the world markets when they put the D.C.2 into production as a fully-equipped ail liner nearly ten years ago the United States are going to be ahead of us for quite a few years after this war in the production of the type of civil aircraft which is suitable for their home consumption and, consequently, for a great many air routes in the world. But their aircraft are not perfect, they are not necessarily cheap to operate, and they are not suitable for all conditions. While we are preparing, perhaps, to compete with America in her own pet lines of civil aircraft, let us stop talking so much about future projects and go vigorously ahead in the production of more modest types which will still fill the inevitable gaps in the market. Not every operator wants a Super D.C.3, or Constellation, or Brabazon, or Mars, but they will *all* want reasonably fast, economical, medium-sized aircraft for feeder lines and for those routes which have not yet been fully developed.

While the giants and Super-Constellations are coming along for our own and other long-distance subsidised air routes, there is our market all ready and waiting. Since the States are well-suited to medium-large, fast, long-range civil machines, and since their aircraft industry is not likely to go into production with types whch have not got an assured home market, they are likely to leave the medium and small classes alone. The British aircraft industry has shown itself to be rather good at producing aircraft in just those classes. No doubt any pre-war American visiting a British airfield and seeing a mass of Rapides and 86s about the place laughed his hat off at these quaint wooden biplanes, but these so-quaint devices were nearer to being self-supporting at reasonable fares and rates than any other aircraft of the period, and they continued to be economical when they were used over short distances.

Ton-Miles-per-Gallon

Not that I am suggesting a return to pre-war standards in such medium types. The sort of thing I have in mind will be a good deal faster, but will carry the same sort of load at the same figure of ton-miles-per-gallon, and will look, for the sake of the very "educated" passengers, like a smaller version of the long-distance aircraft. Speed, of course, will have to be paid for in the longer take-off runs and higher landing speeds for which all modern airfields are well suited. In the old days one of the greatest limitations in the design of such types was in the runs generally available at provincial and back-of-beyond airfields, but all that has been radically altered in the last four years, and even the most parsimonious city fathers will sniff at the idea of laying out a landing ground with less than a thousand yards in at least three directions.

We can, in fact, safely design utility types for such conditions—which are neither so outrageously expensive nor unreasonable by modern standards. In the old days one laid out, for example, an L-shaped or square-shaped turfed area of more than half a million square yards, waited for the surface to consolidate, and then invited the private owners and operators to do their worst after an expensive opening display. The private owners and operators duly complained of the mud-heavy and bumpy surface, and of the obstructions in the way of trees and local hostelries which littered the boundary but they got to work. Nowadays there is no need to flatten the whole of such an area, and islands of vegetation or buildings can be left here and there as conditions warrant, so long as at least a trio of thousand-yard runways are available, with at least five hundred yards at each end of obstruction-clear passage and a fair space on each side of the runways for ground-looping performances in difficult circumstances.

In all probability, the first series of the suggested medium-sizers will be in wood rather than metal, so that development and initial production can be faster. The Mosquito should have cured everyone, including the general public, of any idea that a wooden aircraft in the modern style is out-moded or incapable of standing up to hard out-of-doors' treatment. Maybe even wood, compressed wood, sand

MAKING OUR OWN FUTURE

wiches, plastics, and what-not will finish off metal for all kinds of aircraft construction—but that can always be reconsidered later. We shall want good aircraft of the right type, and we shall want them quickly. Power units may be a problem, since the war does not encourage the production of engines of the 300 to 400 h.p. size, and it will be a pity to use American engines if we can produce our own in time. Not that there is anything against the use of four medium-blown in-line engines of 200-odd h.p., with c.s. airscrews, in the place of two rather larger engines. The travelling public like to see lots of motors, since a lot of them still have the idea that an aircraft drops out of the sky smartly as soon as its engines stop.

Whatever we decide to do, let us not make a lot of unfulfilled promises, let us not talk big and do nothing, and let us not pretend that anything we've got to sell is any better than it really is. That game is played out, and the world is going to be full of a lot of awfully matter-of-fact, rationalistic, and somewhat cynical people when this war is over. We can, if we try, make better mouse traps and better aircraft than anyone else in the world. If they *are* better, we can afford to make them just a little more expensive than anyone else's. We've got a hard, if friendly, fight in front of us in all industrial production; if we can't compete in quantity, then we must be more ingenious and, as in the old days, make things better and more lasting. As far as aircraft development is concerned, we've shown during and immediately before this war what we can do, and there is no reason why we can't show the same energy and initiative in the peacetime world. INDICATOR.

Six Months of U.S.S.T.A.F. Operations

IN the first six months of its existence, says a report issued from Headquarters, U.S. Strategic Air Forces in Europe, the United States Strategic Air Forces in Europe has already seen the achievement of certain primary objectives:

(1) To reduce and neutralise the German Air Force, in being and in production, to such an extent that our bombers would have reasonable freedom to carry out attacks with accuracy and without excessive loss.

(2) To achieve complete air supremacy, in co-operation with the Tactical Air Forces, before D-Day, thus preventing aerial interference with the Allied landings and making possible aerial attacks on the enemy's ground forces.

(3) To curtail the oil supply needed by German ground and air forces by wrecking the factories which refine natural oil or manufacture synthetic oil.

(4) To curtail other German war production by attacks on critical factories such as those manufacturing chemicals, electrical equipment, internal combustion engines, steel, submarines and tanks.

These objectives have all been attained. The German fighter force, which in early January was still a potent factor, is now no longer able to replenish its losses or prevent us from attacking whatever we choose. For weeks before and after D-Day German aircraft have been scarce in Normandy, and they were completely powerless to interfere with the invasion. Oil refineries have been severely damaged, and the supply materially reduced, although there is still much to do. Other war production has been interfered with by attacks on a great variety of key targets. The U.S. Strategic Air Forces in Europe is a combination of heavy bomber forces encircling Germany and the Occupied Countries from West, South and East.

In the first six months of 1944, this triangular force has grown to great proportions. Each month the bomb tonnage has gone up and the targets attacked simultaneously increased.

The totals for the first six months of 1944 are as follows:

Bomb tonnage, 263,483 tons by heavy bombers; 2,744 tons by fighter bombers. Total tonnage, 266,227 tons.

Bomber sorties, 138,897; fighter sorties, 103,952. Total sorties, 242,849.

Enemy aircraft destroyed in air: by bombers, 3,212; by fighters, 2,897. Total enemy aircraft destroyed in air, 6,109.

Enemy aircraft destroyed on ground, 1,546 by fighters.

Total enemy aircraft destroyed in air and on ground, 7,655. (This does not include aircraft destroyed on the ground by bombers.)

Our own bombers missing in action, 2,339. Our fighters missing in action, 1,086. Total missing, 3,425.

The bomb tonnage averages 44,371 tons a month. The number of enemy aircraft destroyed averages 1,018 a month in the air and 257 a month on the ground. Our aircraft missing averaged 1.4 per cent. of the forces despatched.

The freedom from full-scale fighter opposition, experienced by our bombers in the continuing offensive against Germany's oil supply and other targets is the product of air attacks begun last year against aircraft and ball-bearings factories and carried on with the greatly increased forces available this year. During the good weather of February 20 to 25 major blows were struck at the various fighter factory complexes, consisting of parts plants and assembly centres in the Leipzig-Bernburg-Oschersleben-Halbertstädt area, Regensburg, Augsburg and other points inland. In March, April and May we continued to attack aircraft factories, hitting ball-bearings factories and plants making Dornier and Junkers bombers as well as fighters, and returning to fighter factories to bomb them again if they had been repaired.

Early in March full-scale daylight attacks on Berlin began. At first strong enemy fighter reaction took place, but it diminished and, on cloudy days, there was little or none.

During these months enemy opposition was spotty. Occasionally there would be battles in which we would lose 40 or 50 aircraft and destroy from 75 to 150 enemy aircraft, but the number of aircraft engaged never again approached the continuously high figure of late February and early March. During attacks on French airfields and tactical targets generally, often the *Luftwaffe* offered little or no resistance, and before and after D-Day it has let the German ground forces take aerial punishment with very little opposition.

The weight of the U.S. Strategic Air Forces' effort has gradually stepped up over the six-month period. In January these air forces dropped more than 22,000 tons (American). In February the figure rose to 24,000 tons. In March the bomb tonnage was 30,000. In April it was 43,500, in May 63,000, in June 82,000.

The same sort of increase occurred in the number of aircraft employed. In March there were 12,501 bomber sorties and 16,515 fighter sorties. This stepped up until in June there were 36,100 bomber sorties and 29,520 fighter sorties.

The size of the forces sent out on individual days also increased tremendously. The co-ordinated attacks of February 20-25 put approximately 1,300 bombers and 1,200 fighters in the air at one time. But in late June there were approximately 2,000 bombers and 1,500 fighters on the biggest combined missions.

During the six-month period there was a steady increase in the use of instruments which permit bombing through clouds. This increased the number of days on which the bombers could operate.

Air bases in Russia were established and during June several missions were flown from Italy to Russia and from Russia to Italy. The first mission from England to Russia took place in June, the bombers attacking an oil plant not far from Berlin, on the way east. On the way back, these bombers and their long-range fighter escort flew from Russia to Italy, attacking targets in Galicia, and then proceeded a few days later from Italy to England, attacking communications targets in southern France.

With attacks coming from three directions, the reduced German fighter force was compelled to spread itself even thinner.

About six weeks prior to D-Day, purely strategic bombing efforts began to taper off for the time being, and increasing attention was paid to airfields, railroad yards, bridges, supply dumps, troop concentrations and other targets within France and on her borders, in Germany, Holland and Belgium.

Increasingly large numbers of heavy bombers and fighters were diverted to co-ordinated attacks with the Tactical Air Forces. Attacks were made simultaneously on ten or twelve tactical targets at once, with comparatively little resistance from the *Luftwaffe*.

These attacks began at some distance from the northern French coast, then gradually drew nearer to the place where the invasion was to start. In this period about 70 enemy airfields were hit, some of them many times. At least 25 railway and highway bridges were bombed.

During D-Day the heavy bombers flew 2,300 sorties

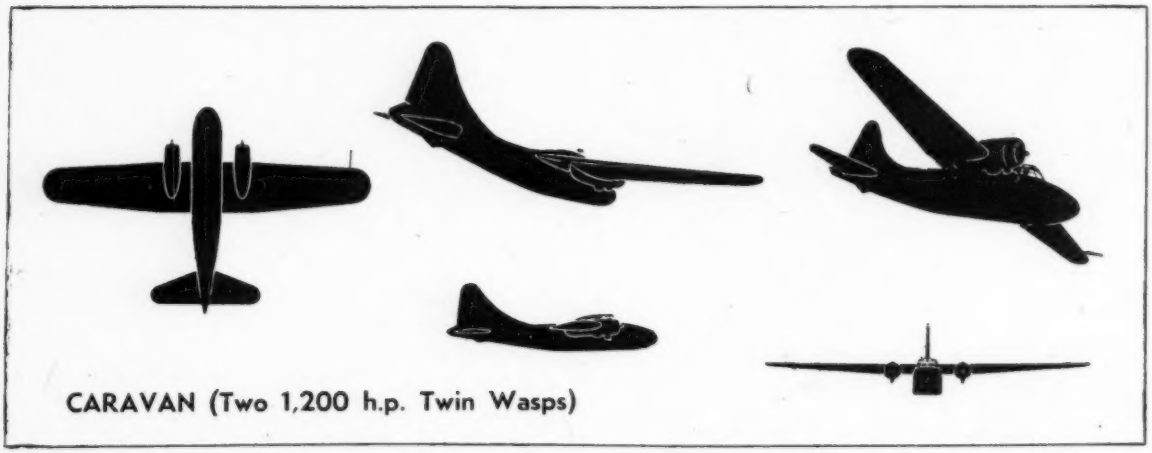
THE PERFECT TAIL WHEEL ANTI-SHIMMY DAMPER *(fully patented)*

LOCKHEED
TRADE MARK

AUTOMOTIVE PRODUCTS COMPANY LTD., ENGLAND

Studies in Recognition

Aircraft in Fl

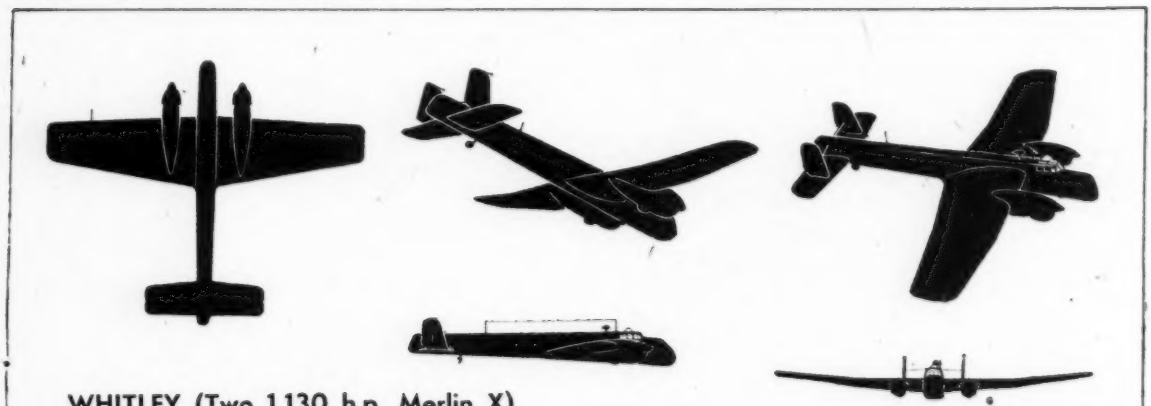


CARAVAN (Two 1,200 h.p. Twin Wasps)

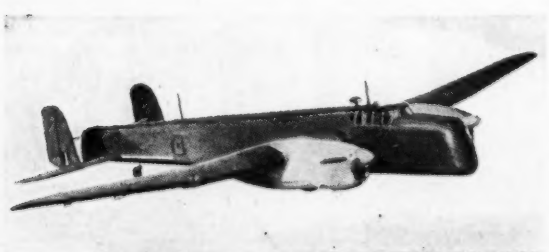
DESIGNED specifically as a military transport, the Curtiss Caravan, which has the U.S.A.A.F. designation C-76, has a wooden airframe and a hinged fuselage nose section permitting the entry of bulky freight. A high wing and tricycle fuselage result in a low and level floor, while the rectangular-sectioned fuselage also facilitates ease of cargo stowage and maximum interior space. Power is provided by two 1,200 h.p. Pratt and Whitney Twin Wasps.

Comparable in size with the all-metal Curtiss Commando, the Caravan aims at sheer utility. Its high wing has a rectangular centre-section and outer panels tapering slightly to semi-circular tips; its tailplane is wide, has a backswept leading edge, straight trailing edge and semi-circular tips, and its tall single fin and rudder has a large spinal fillet. The cockpit cover is raised. Dimensions:—Span 108ft., length 66ft. 3in., height 28ft., wing area 1,497 sq. ft

Curtis Caravan (C-76) Transport.



WHITLEY (Two 1,130 h.p. Merlin X)

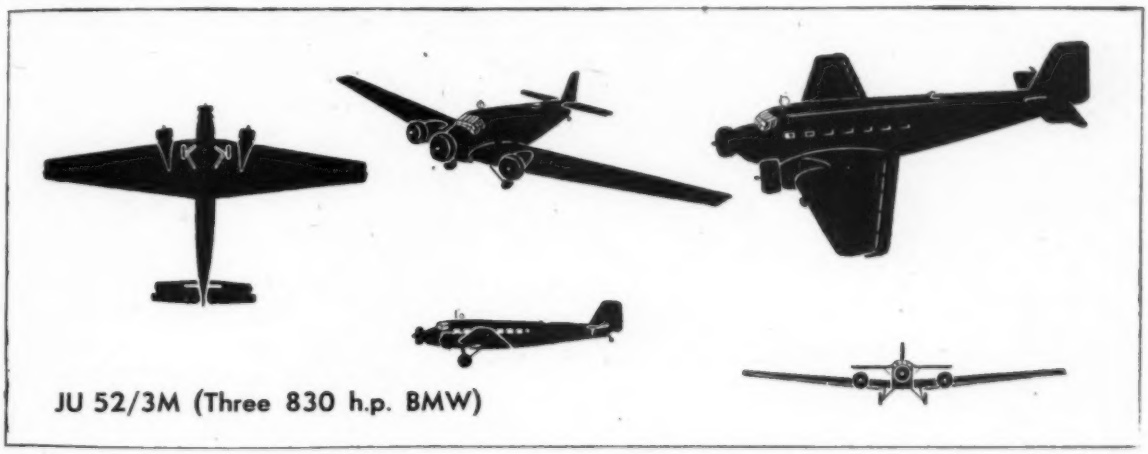


Armstrong-Whitworth Whitley Transport.

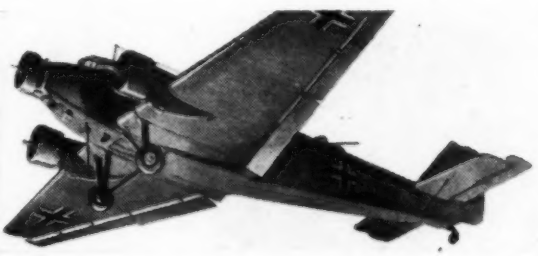
OLDEST of our twin-engined bombers classed as "heavy" in 1939-40, the Armstrong Whitworth Whitley is still giving valuable service as a paratroop trainer and glider-tug (non-operation). An unusual version, however, is a civil transport conversion originally carried out for B.O.A.C. Twelve Whitley V's powered by Rolls-Royce Merlin X engines each of 1,130 h.p., were acquired by the corporation and "civilised" by the removal of nose and tail gun turrets. But though the fuselage of the Whitley is a deep rectangle and to some extent makes up in length what it lacks in width, it would hardly be able to cope with very bulky items of freight and its usefulness as a transport would therefore be limited.

Apart from the fairing off of nose and tail, the familiar Whitley recognition characteristics remain the same. Dimensions:—Span 84ft., length 70ft. 6in., height 15ft., wing area 1,137 sq. ft.

Flying Attitudes



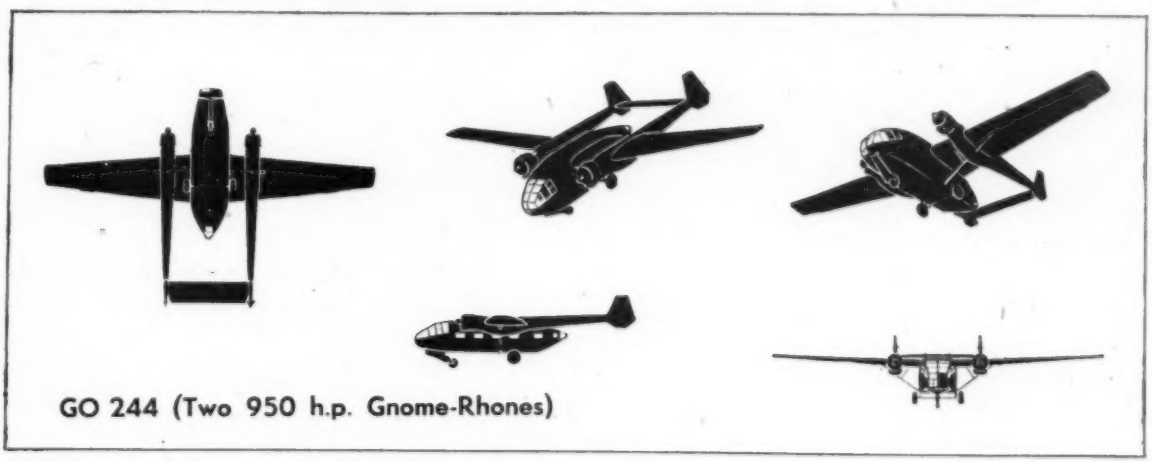
JU 52/3M (Three 830 h.p. BMW)



Junkers Ju 52/3M Transport/Tug.

MORE than a decade has passed since the Junkers Ju 52 first made its debut. Scores of these were produced as airliners and were operated all over Europe by the *Deutsche Lufthansa*. The Ju 52 bomber equipped the first *Luftwaffe* squadrons in 1935, and since 1937 has been the standard German paratroop trainer, troop transport, freight carrier and glider tug. Three 830 h.p. BMW radials provide the power. Hundreds of them have been used in every theatre of war.

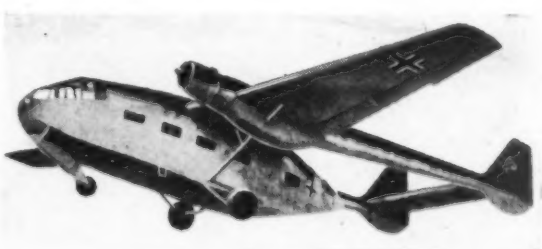
The symmetrically tapered low wing with its small square tips is notable for the "double-wing" type of flaps and ailerons extending along the entire trailing edge; elevators of the angular strut-braced tailplane are of similar type and the large fin and rudder are also angular. The fuselage is slab-sided and has a fixed unfaired undercarriage. Dimensions: Span 96ft., length 62ft., height 14ft. 10in., wing area 1,190 sq. ft.



GO 244 (Two 950 h.p. Gnome-Rhones)

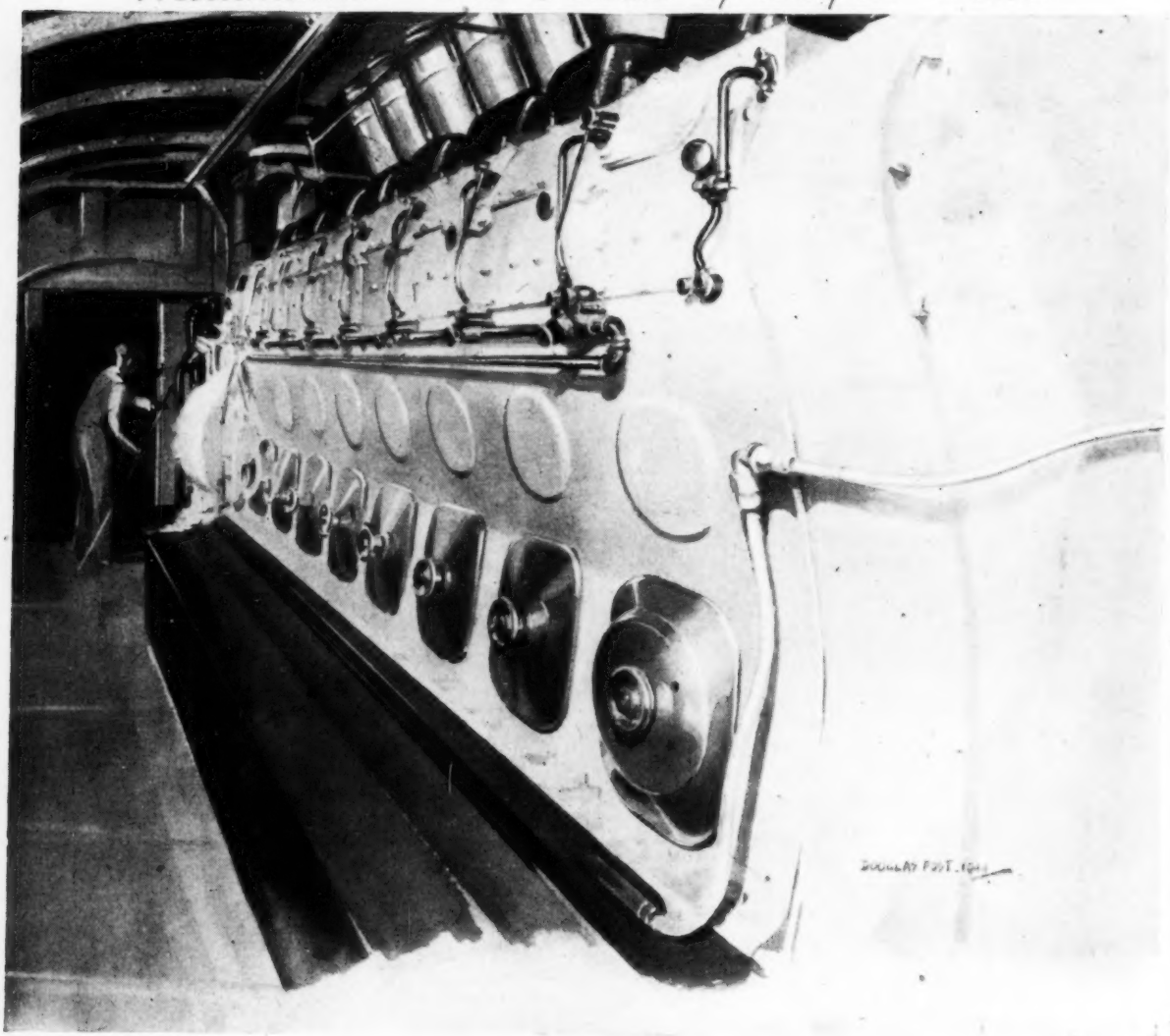
THE Gotha Go 244 transport began life as the Go 242 transport glider and was generally towed by a Ju 52/3M described above. Early versions of the Go 244, sometimes contradictorily called a "powered glider," had the 700 h.p. 14M type Gnome-Rhone, but later versions are fitted with the 950 h.p. fully supercharged 14N type. The main visible features of the aircraft remained the same after it became self-propelled, except for the fitting of a fixed tricycle undercarriage in place of the jettisonable kind used on the glider. The twin-boom construction lent itself readily to conversion.

The high wing tapers on both edges to angular tips and is strut-braced via the nacelles to the bottom of the short, fat fuselage which projects well ahead of the engines. The bluntly tapered tail of the fuselage hinges upwards between the slender booms to receive bulky freight. Dimensions: Span 79ft., length 52ft. 6in., height 11ft. 4in., wing area 762 sq. ft.



Gotha Go 244 Transport.

Hiduminium—The Servant of Swifter Travel



CHANGE ON THE FOOTPLATE

The efficiency of post-war railway motive-power equipment will be greatly increased by the use of **HIDUMINIUM** aluminium alloys. The qualities possessed by these alloys, such as—high strength/weight ratio, good corrosion resistance, ease of fabrication, and ability to take pleasing finishes, will effect many changes in railway rolling stock design—from change on the footplate to a redesigning of the smallest fittings in passenger compartments. New ideas need new materials, and Hiduminium—indispensable in War—will play just as vital a part in Peace in almost every British industry and trade. Technical data is available from the Sales Department on Request.

HIDUMINIUM
ALUMINIUM ALLOYS

HIGH DUTY ALLOYS LIMITED SLOUGH

Fire Risk in Aircraft

Where and How a Fire is Likely to Start, and Some Suggestions for Improvements in Fire-prevention Equipment

By S. W. G. FOSTER, A.F.R.Ae.S.

THIS article is an attempt to clarify the fire risk position. It offers some suggestions for means by which this risk could be reduced to a minimum.

Fire in aircraft is caused by such things as spilt fuel and oil, hot metal, short-circuits in the electrical system, static discharges, and sparks struck from the ground when landing. It is a well-known fact that petrol and oil are liable to be "flashed off" when coming into contact with hot objects such as exhaust pipes, manifolds, dampers, etc.

Vapour and fumes collecting in an enclosed space are also a source of great danger. For these reasons then, it is clear that if the trouble is stopped at its source, such as preventing the petrol or oil escaping from its reservoir, in ordinary conditions as well as in a crash, the fire risk will be considerably reduced.

A crashed Henderson safety tank still leakproof despite damage.

The Henderson Safety Tank Co., Ltd., in co-operation with the Air Ministry, has produced various safety tanks embodying a type of construction which will withstand without bursting impact and distortion in the event of a crash. This in itself contributes a major step to the prevention of conflagration. The Miles Master trainers are fitted with this type of tank as an extra safety precaution.

The walls of the Henderson tank are built up with three layers to a thickness of three-sixteenths of an inch. The inner skin, of copper sheet with soldered joints, is coated with a thin film of "Hencorite," a substance very similar to rubber. This, in turn, is covered with an outer skin of copper sheet, soldered at all joints as in the case of the inner skin. It will be noted that each layer is in itself a complete leakproof unit. Baffles attached to the inner wall of the tanks are secured by a special self-releasing device by which they become detached in a crash, thereby making it impossible for local stresses to be set up. No rivets are used, only soft-soldering. The tanks are rust-proof and do not require normalising. Damage can be easily repaired and the tanks are impervious to climatic conditions.

Safety Tank Weights

In spite of its triple skin, weight of the Henderson tank compares favourably with ordinary non-leakproof types of tank, weighing between 1 lb. and 1¼ lb. per gallon for capacities of 50 gallons and upwards. The tank has been fully tested at The Royal Aircraft Establishment and approved.

It is claimed that these tanks are leak- and fireproof when fired at by incendiary, tracer or ordinary ammunition. Doubtless the extent to which the so-called "bullet-proof" tank has been developed during this present war will have a good effect after the war.

The method of mounting fuel and oil tanks in aircraft also has bearing on the fire question. If a tank is rigidly fixed to the aircraft structures, the inertia of its contents will tend to tear it from its supports in a crash, thereby spilling inflammable liquid.

Let us consider an aircraft landing with its wheels up; assume it touches down at 100 m.p.h. (147 f.p.s.) and it slides 56ft. after its first impact.

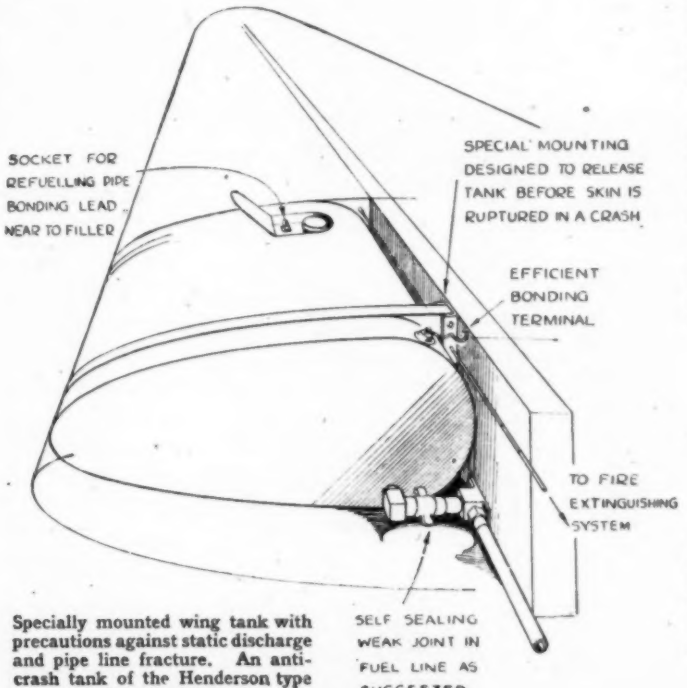
Let a = acceleration or deceleration, in feet per second,
v = velocity of aircraft, in feet per second,
s = distance travelled from first impact to final standstill, in feet.

Then $a = \frac{V^2}{2s}$

$= \frac{147^2}{2 \times 56} = 193$ft. per second $= 6g$.

It is difficult to assess crash conditions, but it is generally accepted that an aircraft sustains structural damage when it is subjected to 6g. Let us consider an elementary case of a tank in the above aircraft, constructed on the Henderson principle, containing 50 gallons of 87-octane fuel and work with the formula

$$F = \frac{WV^2}{2gs}.$$


SOCKET FOR REFUELLING PIPE BONDING LEAD NEAR TO FILLER
SPECIAL MOUNTING DESIGNED TO RELEASE TANK BEFORE SKIN IS RUPTURED IN A CRASH
EFFICIENT BONDING TERMINAL
TO FIRE EXTINGUISHING SYSTEM
SELF SEALING WEAK JOINT IN FUEL LINE AS SUGGESTED

Specially mounted wing tank with precautions against static discharge and pipe line fracture. An anti-crash tank of the Henderson type is suggested.

FIRE RISK IN AIRCRAFT

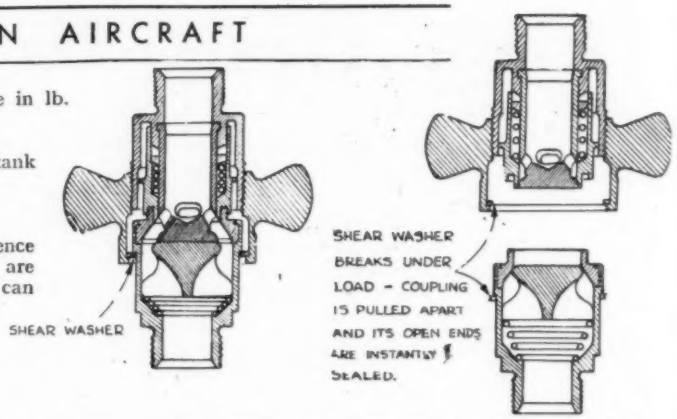
Where F = force produced on aircraft structure in lb.
W = weight of petrol and tanks, in lb.
V and S as above.

87-octane fuel weighs 7½ lb. per gal., and the tank 1¼ lb. per gal.

Then W = (50 × 75) × (50 × 1.25) = 437.5 lb.

Therefore F = 437.5 × 6 = 2,620 lb.

from which it will be seen that under the influence of 6g. the load which the tank and its supports are subjected to is fairly considerable. If the tank can be so mounted that the sudden shock does not rupture the shell but pulls the mounting away from the aircraft structure, then no risk due to spilt contents will be present.



An Avery coupling, modified as shown, would make a self-sealing weak point in fuel and oil pipe lines.

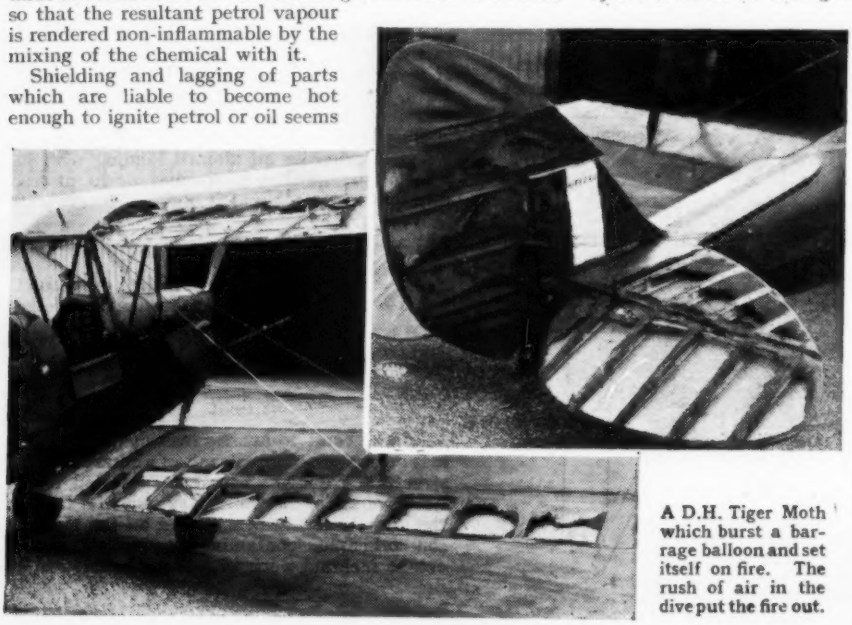
Fuel and Oil Lines

Regarding fuel and oil pipes; if these pipes had to break, a sealing valve could come into operation and stop the flow of liquid. In fact, a weak point could be incorporated to ensure the pipe breaking, it it had to break, at the sealing valve. An Avery coupling, suitably modified as shown in the author's sketch, would admirably answer this problem.

Fuel pipes should also be kept as far as possible from any component that would be likely to cause a fire in the event of a leakage.

The operations of refuelling or jettisoning of fuel whilst flying involve very great fire risks unless certain precautions are observed in the design of the systems. Static discharges can cause fire when jettisoning fuel where it is likely to contaminate the surface of the aircraft adjacent to the discharge port. This can be nullified by ensuring that the discharge nozzle is so designed that contamination could not take place. Design requirements are in being recommending that the volume of fuel left in the tank after jettisoning the bulk, is not to be less than 1 per cent. of the volume of the tank, so as to prevent the formation of an explosive mixture. Sometimes when landing a local explosion occurs in the discharge pipe. This is not serious provided the closing valve will prevent the explosion reaching the tanks, and the discharge pipe is strong enough to withstand such an explosion. With regard to refuelling, there is a scheme in existence whereby methyl-bromide is released when the refuelling connection is broken, so that the resultant petrol vapour is rendered non-inflammable by the mixing of the chemical with it.

Shielding and lagging of parts which are liable to become hot enough to ignite petrol or oil seems to be a worth-while contribution towards the problem of fire prevention. Exhaust manifold systems are probably the worst offenders, and a shielding system could be devised whereby, if petrol or oil were spilt near the exhaust system, the parts with which it would come into contact would not "flash" it off.



A D.H. Tiger Moth which burst a barrage balloon and set itself on fire. The rush of air in the dive put the fire out.

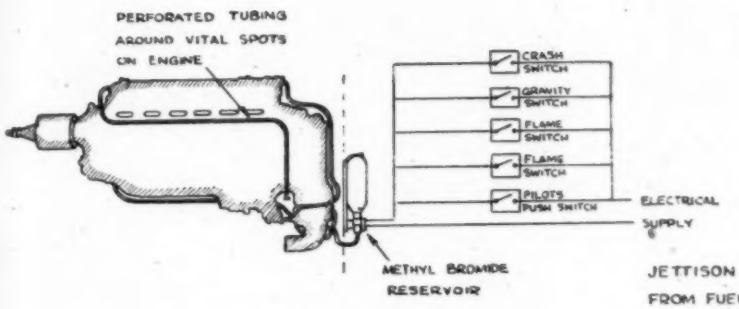
Short Circuits

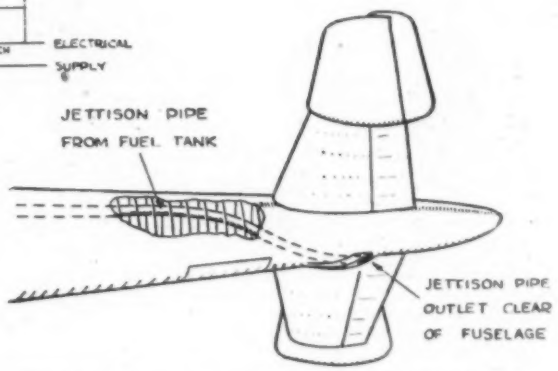
Short-circuits in the electrical system can be protected by such methods as shielding, or prevented by isolating the main source of electrical supply, which is the battery and the engine-driven generator. Some means of immediately stopping the magneto and the generator, rendering the battery incapable of producing a spark, are required. The magneto and engine-driven generator could be stopped by stopping the engine, which seems to be a case for either the feathering airscrew or the airscrew brake.

The battery could be automatically jettisoned just before an imminent crash, or the system so shielded that it would be impossible for any short circuit to cause a fire. The battery could be deprived of the means of causing a spark by short-circuiting under the electrolyte, and if a battery of the NIFE type with metal plates and caustic electrolyte was used, no damage would result if the battery was needed again. Another method would be to discharge the electrolyte from the battery. This is another case for the battery with no cedar-wood separators which could hold a certain amount of liquid. The automatic system could be operated by mechanism similar to that of the Graviner fire-extinguisher system. Accumulators should be provided with adequate ventilation to prevent the accumulation of explosive gases.

Electrical Equipment

The use of electrically operated fuel gauges, pumps, etc., which are adequately protected against sparking is advisable. The Waymouth Gauges and Instruments, Ltd., when describing their fuel gauge, state that there is no electrical connection between the tank and the electrical supply—it is via a





(Left) Typical Graviner installation. The author suggests this system should cover other vital parts of aircraft.
(Below) The jettison pipe of the Dornier 217 fuel system comes out beneath the tail unit.

condenser; therefore, there is no possibility of fire being caused by sparking; only about 1/200 volt is used in the tank. Electrical equipment having moving contacts which are liable to cause fire should be of a flame-proof type.

Static electricity, such as electro-static discharges, corona or brush discharges, is another problem which would have to be thoroughly investigated. Differences of electro-static potential and the consequent risk of sparking may arise from aircraft passing through storms. Aircraft are sometimes found to be electrically charged to a high potential on landing. To prevent sparking at the fuel and oil fillers when refuelling, some positive means is needed for connecting the tanks to the ground when the aircraft lands. Efficient bonding is a step in the right direction. There are recommendations laid down that bonding sockets should be provided at each fuel- and oil-filling point to ensure the electrical connection of the system to the ground equipment. Also the following points are of importance in reducing the fire risk. When plain H.T. cable is used between engine starter and magnetos or booster coils and the isolating spark gap, it should be not less than three inches from metal-braided cables, pipe lines or similar metal parts to avoid the possibility of "corona" effects and high electric stress in the cables during engine starting.

Prevention Systems

Fire-prevention apparatus in existence have the old problem of weight versus efficiency to contend with. The Graviner system, for instance, will only cover the engine nacelle in the event of a fire, and if a fire breaks out, say, near a petrol tank in the wing, unless the pipe-lines of the Graviner system are run over the aircraft to cover all these contingencies, great difficulty will be experienced in extinguishing the fire.

The Graviner system ejects methyl bromide gassed with nitrogen to a pressure of 60 lb. per sq. in., which evaporates with intense cooling effect, thus reducing the temperature of hot parts below ignition point of petrol or oil fuels, and choking any fire that has already broken out. Methyl bromide has the advantage that no corrosion is caused by its passage through the engine. For a weight of 12 lb. the Graviner system carries 3 pts. of methyl bromide. One ounce of methyl bromide, sprayed into 10 oz. of burning petrol, effectively inhibits the fire.

Methyl bromide seems to be a more practical chemical for fire prevention purposes than carbon di-oxide or carbon-tetra-chloride, although the Kidde Lux extinguisher, as used in the D.H. Flamingo, uses carbon di-oxide. Foam would be another method of fire-fighting, but it needs two gallons to cover and extinguish an area of 4 sq. yds. of oil or petrol that is well alight.

There is another system besides the Graviner which uses methyl bromide, and that is the "National Fire Protection's" Autocrash system.

Another method which might be developed for use on aircraft is the "Pyrofuge" bomb. This consists of a "bomb" weighing about 12 lb., which is ignited by a wick which burns down to an explosive core. This bursts the surrounding casing and releases a special fire-choking powder which, when heated, gives off a gas which effectively smothers the flame. The explosion is not violent enough to do any damage whatever and merely serves to spread the powder. In fact, the bomb can be safely held in the hand at the moment of explosion. It will operate when the temperature rises to 275 deg. F. The bomb was an Italian invention, and an English company was being formed for its manufacture.

Fireproof Fabric

A protective covering to make an airman's clothing proof against petrol fires was stated to be under examination by the Air Ministry and Ministry of Aircraft Production. The clothing is covered with a solution evolved after two years' experiments by Mr. G. A. Petzold and Son, research chemists. The cost of the experiments was borne by Sir Hector MacNeal and named the MacNeal process. Tests are believed to be promising. An experiment with asbestos suiting has been carried out by setting alight the skeleton of an aircraft, with a man wearing the equipment seated in the cockpit. He remained there for four minutes until the flames subsided. The heat reached 1,500 deg. F., and the man suffered no ill-effects.

It appears that Lockheeds have been taking the fire risk seriously, as the Lockheed Constellation has an electrical system of combating fires, and the risk of fire is lessened by having the nacelles and cowlings made of stainless steel which, it is stated, can withstand the heat of conflagration for half an hour.

It will be interesting to note the effects that jet and rocket propulsion have on the fire risk. Doubtless, the people concerned in the design of such things are fully aware of the dangers and are doing all they can to reduce the possibilities of fire.

Therefore, summing up, the list of equipment required for combating the fire risk in aircraft is as follows:—

1. Crashproof tanks for petrol and oil.
2. Self-sealing couplings in pipelines.
3. Isolation of parts liable to cause fires.
4. Provision of a really efficient automatic fire extinguishing system.
5. Electrical apparatus which is protected from short circuits and subsequent sparks.
6. Isolation of source of electrical supply.
7. Shielded or cooled parts which are liable to become hot enough to ignite petrol or oil vapour.
8. Extensive use of fireproof paint.
9. Prevention of static discharges, etc.
10. Prevention of sparking from ground when crash landing.
11. Fireproofed clothing and upholstery.
12. Provision of an efficient form of cabin ventilation so that any flames liable to be sucked into the system can quickly be isolated.

Behind the Lines

Jap Precautions

APART from Tokyo, the cities of Yokohama, Kawasaki, Osaka and Kobe have been declared by the Japanese Ministry of Interior as special "air defence" areas. Among other regulations applied to these cities, the order prohibits the erection of factories with the exception of special plants for the armament industry.

Mistake

WITH assurances that steps will be taken to prevent the repetition of the incidents, the German Government expressed its regret to the Swedish Government that two air torpedoes crashed in South Sweden on May 11th and June 13th.

Since according to the German official statement the incidents occurred in the course of experiments, it can be assumed that such experiments are being conducted somewhere in the northern parts of Germany or on one of the smaller islands in the Baltic.

Wanted: Accuracy

THE use of the V1 on specific target areas in London was threatened by a Wilhelmstrasse spokesman quoted by the German News Agency, says Reuter.

Presumably to impress the German public with the military value of the air torpedo and to demonstrate to the neutrals that the V1 is not just a political weapon, the spokesman said that the first thirty days should be regarded only as a practice shooting to get the range. "London and Southern England have so far felt only the first tremors of the long-range battle."

"V1 series have been worked out separately for the individual target areas, taking into account their wartime importance and the weight of bombs dropped by the British and Americans on single German towns."

The list of targets is headed by the following London districts: the City, the docks, the industrial area of East London.

From the *Luftwaffe*

KNIGHT'S Cross Insignia to the Iron Cross have been awarded by Hitler to Gen. Ritter von Pohl, A.O.C. the *Luftwaffe* in central Italy, Gen. Schlemm, A.O.C. a parachutist corps, and Maj. Gen. Schultz, Chief of the General Staff of an air fleet.

The citation of Gen. von Pohl says that he distinguished himself as a General Staff officer "of organising ability and splendid initiative"; Gen. Schlemm was in charge of the defences after the landing at Nettuno, and Maj. Gen. Karl-Heintz Schultz served as a staff officer in the western, in the Balkans and on the Russian front.

The death in action of Maj. (acting Gen.) Wolfgang Redlich, group commander of a *Luftwaffe* fighter wing, is reported by the German Radio.

Redlich, who was a holder of the Knight's Insignia to the Iron Cross, was credited with 41 air victories.

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

Not Practicable

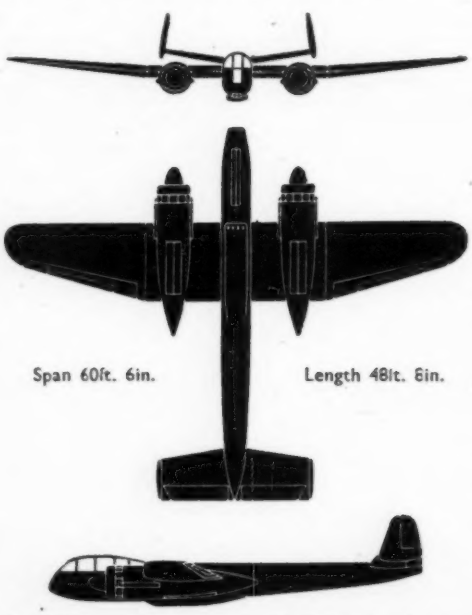
THE employment of the "V.1" on the eastern front is improbable, a German military spokesman stated recently. He pointed out that on account of the vast expansion of this front, the Soviets would be in a position to evade sites against which the "V.1" fired, concentrating their troops elsewhere, so that the military purpose behind the use of the "V.1" would not be attained.

Air Transport

REPORTS in the Japanese Press state that the military administration of North Borneo has recently opened a regular air service between the main localities of Borneo.

The Japanese-controlled Manchurian Air Transport Company has added to its network within Manchukuo a regular service to Peking and the China State Air Transport Company of the puppet government in Nanking, operates regular services from Nanking to the interior, its most important route being the Shanghai-Canton service.

In Thailand another Japanese-controlled company operates services from Bangkok to the eastern and southern areas of the country. At Nongkhai this network links up with the passenger service operated since the beginning of August, 1943, by the Air France from Hanoi to Vientiane in French Indo-China. This company also operates a service between Hanoi and Saigon.



The He 219 fighter powered with DB 603 engines.

Berlin Sirens

LT. GEN. KRESSMANN, Commander of the Berlin Flak division, gave these details of the German air-raid warning system.

"Approaching enemy aircraft are reported to the air defences while they are still far from the Reich frontiers. This is done by direct and indirect observation and the use of most up-to-date equipment over a closely knit network spreading from the patrol vessels at sea, over countless observation posts right to the nerve centre of the defence, the *Luftwaffe* Defence Headquarters. It is from here that the sirens are sounded and wireless messages sent out.

"Information over the wireless is given when the approaching enemy is still 30 to 60 minutes' flying time by the shortest route from the area covered by the wireless report. The wireless only appraises the situation, and as long as the sirens are silent it is only meant to allow people to prepare themselves for the shelters and to take any other necessary action.

"Berliners cannot be told as much as they might like to know, 'for the enemy might listen in and then draw deductions which would lead to results harmful to the capital; but intervals between the reports should not be more than four to five minutes.' For the benefit of those who have been unable to listen, in Berlin all wireless reports are to be repeated after one minute has elapsed."

The A.A. Commander then reassures the Berliners that during every alert he has his headquarters in the control room from where he gives orders for the defence and personally writes the text of each wireless message which is then relayed over the microphone by a specially selected officer.

Sirens are sounded the moment plotting maps in the command post of the divisional H.Q.s indicate that the enemy raiders have approached within a certain distance. These "alarm zones" are fixed at distances from which the enemy—if he chooses the shortest route—can reach Berlin in ten minutes by day and in about 15 minutes by night.

"As even the most reliable person may make a mistake and the best electrical instruments may fail at times," explains Gen. Kressmann, "it may sometimes happen that the enemy arrives over his target even before the above-mentioned time limit. In many cases, however, after passing the alarm zone the enemy will prefer to make a detour either to evade the fighters or the A.A. guns or to conceal his real objective as long as possible."

"This," says the general, "the defence headquarters cannot, of course, predict, nor can they wait until the last minute before sounding the sirens. It is therefore unavoidable that intervals of varying length should occur between the air-raid warning and the actual beginning of A.A. fire or the attack. It follows that the population *must, as soon as the sirens are sounded, proceed to the air-raid shelters.*"

Bear up old man!

"That's the bother. I am old. I'm losing my bearings altogether. Why aren't you the sort of seal that really seals, if you know what I mean?" Ah! You want a SuPerfect Seal, definitely. Do yourself a kindness and fill up the Seal Questionnaire." ★

★ What is your sealing problem? Does it concern oil, water, chemicals, gas, grease? Hand it on to the specialists—send for the SuPerfect Seal Questionnaire, complete it, and we will work out the answer.

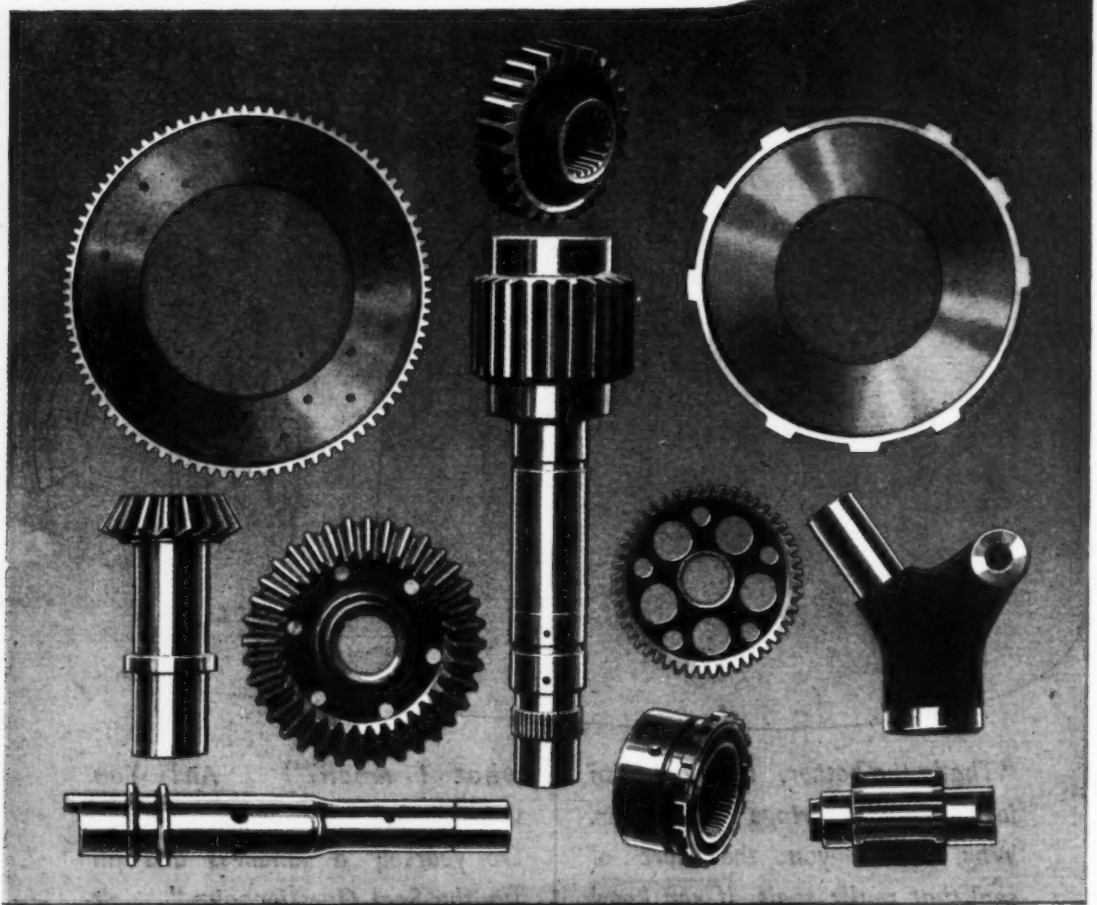
Enquiries are invited from Manufacturing and Engineering concerns

SUPERFECT

SUPER OIL SEALS & GASKETS LIMITED

BIRMINGHAM FACTORY CENTRE, KINGS NORTON, BIRMINGHAM, 30

PRECISION ENGINEERING



HOBOURN AERO COMPONENTS LTD

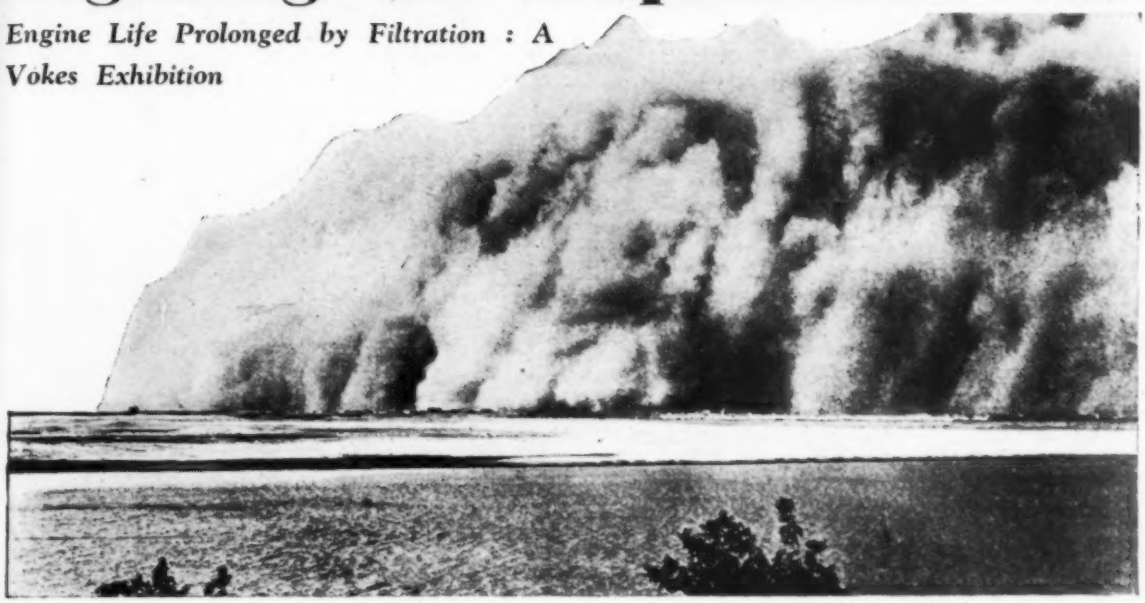
CASH'S LANE COVENTRY

SPECIALISTS IN THE MANUFACTURE OF

COMPLETE ASSEMBLIES & COMPONENTS

Fighting an Implacable Foe

Engine Life Prolonged by Filtration : A Vokes Exhibition



DESERT DUST STORM: Pilots in Libya report having flown through dust-laden atmosphere as high as 17,000ft Visibility in a storm such as this is as little as three feet.

AN exhibition of the means used to combat one of the most implacable foes our mechanised forces have to fight was recently opened at Messrs. Vokes by Mr. A. T. Lennox-Boyd, M.P., Parliamentary Secretary to the Ministry of Aircraft Production.

The exhibition itself is of great interest and not only shows the multiplicity of diverse filtering and silencing problems that have been tackled, but also makes it quite clear that filtration is one of the most important adjuncts to the efficient operation of engines. Another point which is demonstrated is that dust, or minute sand particles, has basically the same characteristics no matter where it is found—and very surprisingly, dust is found in the middle of the Atlantic as well as in North Africa.

During our campaigns in the Middle East and the Far East, numerous of our aircraft were fitted with "tropicalised" air intakes, and illustrations of various types have been published from time to time in *Flight*. Not all of our machines, however, were so fitted, and in cases where no means were possible to combat the amazingly destructive effect of dust, the percentages of aircraft grounded and unserviceable and the flying life of the engines were appalling.

It is not difficult to visualise the effect of dust inside an engine when it is realised that before a serious inroad can be made against engine wear, 97 per cent. (by graded size) of foreign matter must be removed from the air, oil and fuel. The remaining 3 per cent. is the most difficult to remove, being composed of matter between one and five microns in size; one micron = 0.00004in., that is, one-hundredth the thickness of the average human hair. The highly critical performance required of filters, if they are to be of any real good, can thus be easily understood.

Where some filters fail is that general operating conditions introduce a variety of densities, velocities and particle sizes of dusts, with the result that in any conditions other than those for which the figures claimed the filters are virtually useless. One of the secrets of the success is the ratio of filtering element area to volume and velocity of flow. In Vokes air types the area of the filtering element is 200 times the area of the inlet and outlet ports, and on their oil filters the ratio is 600:1. By utilising so generous a filtering area in relation to the inlet and outlet areas, obviously the speed of the media through the filter element is reduced to a very low figure, and this enables deleterious matter to be arrested with very low back pressure losses.

Dust Particles

It seems amazing at first sight that dust, with which we are all familiar, can have such a tremendous effect upon the wear of an engine. The dust which does the real damage is as fine as face powder or flour, is sometimes composed of as much as 85 per cent. quartz, which is harder than steel, about 0.7 the hardness of diamond, and consists largely of angular and sub-angular grains. Dust particles of 5 to 15 microns in size get between bearing surfaces, span the oil film, and cause extreme abrasions. Particles of less than one micron cannot span the oil film and are relatively harmless.

As a brief illustration, the wear on bearing surfaces in the average pre-war car was about 0.001 to 0.0015in. per 1,000 miles on English roads over 10-15,000 miles running period.

With aircraft engines it can be said, in general, that any make in the world is in serious trouble within 35-50 hours' flying in dusty conditions, and large numbers have been reported as seriously damaged in as low a period as 10 hours. On the 35-50 hours basis the engines are so badly damaged that a serious major overhaul is necessary, and frequently the engine is not worth any attempt at repair. With a really efficient filter fitted, however, reports indicate that engines are giving 180-200 hours service.

During the Libyan campaign, for instance, it was noticed by our pilots that large numbers of Italian aircraft could be seen lined up on the various airfields, as well as considerable numbers of tanks and vehicles outnumbering those possessed by our Forces. Yet very few aircraft ever seemed to be flying nor were the tanks or armoured cars in motion, and it was not until Sidi Barrani and Bardia were taken that it was found that practically the whole of these vehicles and aircraft were completely unserviceable due to sand dust having ruined their engines.

Rotol Cabin Supercharger

Ground Level Conditions Maintained at All Heights : Full Air-conditioning for Cabins

FOR a considerable time Rotol, Ltd. (of airscrew fame) have interested themselves in auxuliary units, the latest of which is a pressure cabin supercharger. This has been developed to a stage of efficiency which maintains the interior of the aircraft cabin at an air pressure corresponding to the atmosphere at 10,000 feet at any height up to 40,000ft. In addition, the air is warmed so that the cabin interior is maintained at a comfortable temperature all the way up to the aircraft's ceiling.

As a result, passengers and crew need neither oxygen masks nor special clothing. In fact, during some experimental flights in the stratosphere a little too much heat was provided; the crew removed their coats and sunned themselves through the roof, high above the clouds.

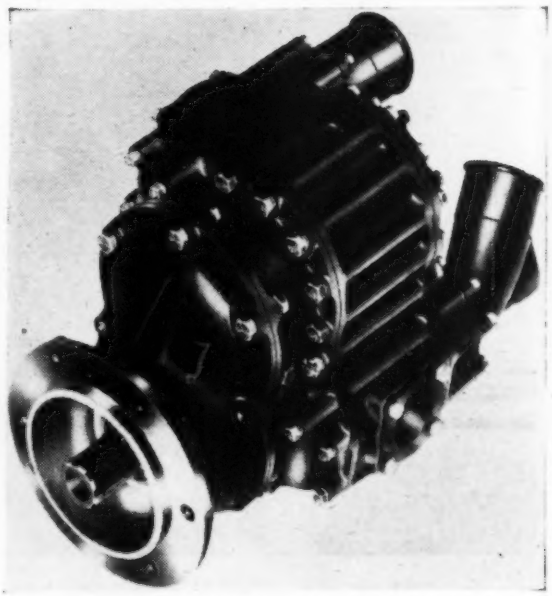
The superchargers are attached to, and driven by, the inboard main engines. For safety's sake, two superchargers are provided, each capable of delivering the requisite amount of air. This quantity is determined by the breathing requirements of the passengers and crew plus that required to produce comfortable ventilation.

Control of Airflow

Unless the aircraft cabin has been specially designed to be airtight, the various leaks may pass more air than is required for ventilation. In such cases extra large units are required or a lower pressure must suffice.

In a completely airtight cabin the flow of air is controlled by a valve, which permits it to escape at a predetermined rate. For civil aircraft this valve is controlled automatically by an aneroid device. The valve is progressivly closed as the altitude increases.

The supercharger is of the displacement type, and has two spindles running inside an aluminium casing and carrying two rotors which interact upon each other without actually touching each other or the casing. No sliding or rubbing parts can be tolerated in the pumping chamber, because no oil must be permitted in the latter in any circumstances. Unless the blower chamber is absolutely free of oil, the air will be contaminated and will make conditions unpleasant in the cabin. This requirement introduces a mechanical problem because the supercharger is attached to and driven by an aircraft engine full of hot oil. Moreover, the driving gears of the supercharger, although outside the pumping chamber, are running at high speed and need to be drenched in oil.

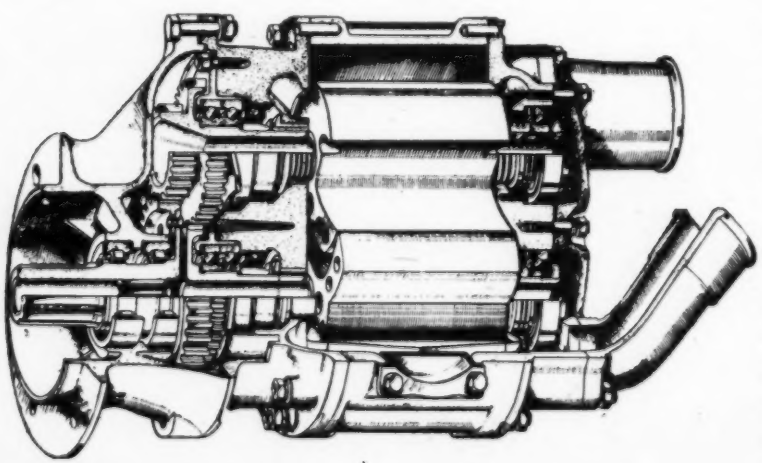


An external view of the complete supercharger unit.

Early designs included conventional types of oil seal between the driving gears and the blowing chamber. This was satisfactory until the seals began to wear or the crankcase back pressure rose for some reason. Finally, the problem was ingeniously solved by separating the driving gear oil seal from the pumping chamber by an annular space drained and vented to the outside atmosphere. The pumping charger spindle is sealed by a non-rubbing steam-turbine type of labyrinth. The latter is fed with compressed air bled from the supercharger delivery. At the sacrifice of some air, this system ensures that at all times there is "one way traffic" of air flowing from the pumping chamber out through the drain. Any oil escaping from the driving mechanism is thus discharged harmlessly overboard. This system is so effective that the units have been run experimentally for long periods with no sealing device on the driving gear side. This resulted in heavy loss of engine oil through the drains, but none whatever gained ingress to the air pumping chamber.

Owing to the compression of the air (which increases with altitude), the delivery temperature steadily increases, until at maximum altitude it may exceed the temperature of boiling water. This increase conveniently coincides with the exterior drop in air temperature. However, to discharge the heated air directly into the cabin might cause uneven heating and result in discomfort. It is usual, therefore, to admit the air into the cabin between surfaces of the double-skinned windows and pilot's windscreen. This system also has the merit of keeping the windows free from cloudiness or frost.

As already mentioned, the air in the cabin after doing its work is discharged



Sectional drawing of the supercharger unit showing the rotors.

to the outside atmosphere through any small leaks in the structure, but chiefly through the automatic escape valve. In addition, the vitiated air may be discharged through the turbine gyroscopes of the various navigation instruments (in unsupercharged aircraft special vacuum pumps are required for this purpose). In large aircraft equipped with auxiliary electrical plant driven by small engines, the vitiated air may be used to supercharge these engines.

For large post-war civil aircraft, designs have been prepared, by which the passengers' and crews' compartments will be closed from the start. Full air-conditioning will be provided, including refrigeration, heating, drying and humidifying apparatus in addition to the superchargers, by which the cabin conditions will be maintained at comfortable ground level conditions whether the machine is in the stratosphere, near the ground, in the tropics, or the Arctic regions. Young and old, weak and strong, will be able to fly at any height over any part of the globe.

Post-war Private Aircraft

Shall Military Types be Made Available or Scrapped?

By ALAN GOODFELLOW

THE author, who is now a Commander (A) in the Fleet Air Arm, was very prominent in private flying circles in pre-war days. He is on the committee of the Royal Aero Club and, therefore, writes with considerable authority and experience.

AT the moment nobody can say what the post-war situation is going to be. We do not know whether there are going to be any clubs, any Civil Air Guard, or any private owners. We do not know whether the Air Ministry wants to encourage them or to discourage them. Perhaps the Air Ministry itself does not know; at any rate, it refuses to say anything definite. The one thing we do know with certainty is that there are plenty of light and medium-light aircraft in this country at the moment, and that unless they are all scrapped there should be an ample supply available after the war to meet any possible requirements.

The types available include the Tiger Moth, Magister, Proctor, and Auster among the light aircraft, and the Dominie, Oxford and Anson amongst the medium types. (There are also several American types, but these are excluded from the list, owing to possible difficulty in obtaining spares.) All these types are readily adaptable for use by schools, clubs, or private owners. Many of the aircraft concerned could have the necessary adaptations carried out by the parent manufacturers and be overhauled up to certificate of airworthiness standard at a very modest cost. Would it be better to do this or would it be better to scrap the lot and to start afresh with new designs? Let us consider the arguments on both sides.

In favour of scrapping it may be argued that the manufacturers will not want the market flooded with cheap second-hand aircraft which will ruin their prospects of selling new ones. It may also be argued that to have the sky filled with undisciplined enthusiasts, with the consequent risk of collisions, in the air at a time when a lot depends on building up our commercial air lines with a reputation for regulation and safety, is most undesirable. I do not believe either of these arguments is sound on a long-term view.

Take the case of the manufacturers first. It takes some considerable time to bring a new design to the production stage, and during this time only the experimental and design departments are employed. If all these aircraft are scrapped there will be nothing for the clubs and private owners to fly (unless, of course, they buy from abroad) for probably at least two years after the end of the war. If, on the other hand, these aircraft are handed back to parent manufacturers for reconditioning and modification as required, they will be able to keep at least a fair proportion of their trained men employed, to build up their sales organisations both at home and overseas, and, last but not least, to create a market against the time when their new designs will be ready for sale.

When the war is over many people who are now flying will want to keep in practice, and it will be in the interests of the country that they should be kept in practice. Many more of the older ones will be ready to try the experiment of using an aircraft for business or pleasure, either flying it themselves or employing a pilot, and this will be particularly the case if the first cost of the experiment is a reasonable one. The cost of medium-sized aircraft before the war ran to some thousands of pounds, which is rather a lot to spend on an experiment. The cost of reconditioning and modifying the Dominie, Oxford, or Anson would probably be a matter of a few hundreds of pounds, which would make the experiment very much more tempting.

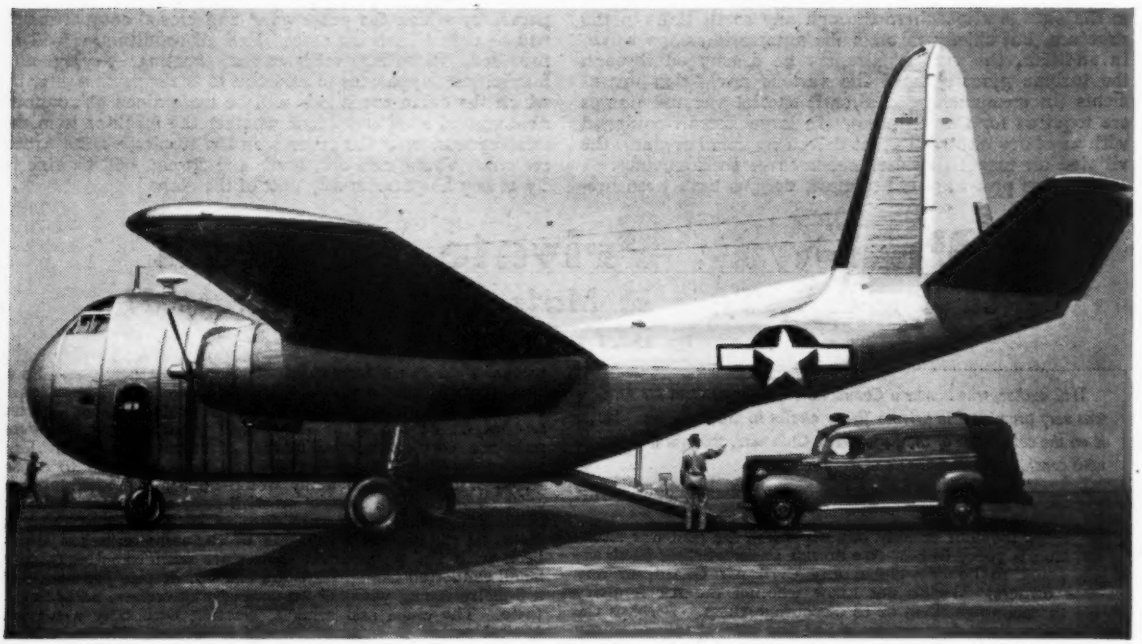
It is not suggested that everyone who purchased an aircraft at the cost of reconditioning would be ready in two years' time to spend the much larger sum required for a new one. Some simply would not be able to afford it, others would have found the experiment unsuccessful from the business point of view and would no longer be interested. There would, however, remain a very substantial market of people who could afford to pay for the new productions and were prepared to do so. Amongst business men many would have found a private aircraft so valuable in connection with their enterprises that they could not visualise the possibility of carrying on without it. Amongst the amateurs it would be the same as it has always been with the yachtsman: You start with something like a small converted fishing boat and end up, despite yourself, with a 6-metre racing yacht or an ocean-going cruiser, according to taste. The clubs and schools, starting with only a nominal capital outlay to write off, would have been able to build up reserves with which to purchase the new types. From the point of view of the manufacturer, therefore, I believe that the arguments in favour of the second alternative far outweigh those in favour of scrapping.

Air Safety

There remains the problem of air safety in connection with our air lines. This is a matter of high policy in which many factors have got to be taken into consideration, and obviously the risk of air collision, with its almost certainly disastrous consequences, cannot be ignored or lightly treated. One thing, however, is clear; either we have got to ban all private flying for the sake of air-line safety, or we have got to encourage it, accepting a degree of risk and imposing only such limitations as are reasonably necessary. There is no half-way house; to permit private flying subject only to almost prohibitive restrictions would achieve no useful purpose whatever.

Personally, I believe that the risks involved must be accepted. Even if all private flying were banned, the risk of collision with Service aircraft would still exist, and most air-line pilots and passengers could tell of narrow squeaks in this connection even in the days of our small pre-war Air Force. Some restrictions, of course, will have to be imposed. Private aircraft not in wireless communication with the ground may have to be kept out of the clouds—and out of the air altogether in Q.B.I. conditions. Certain zones or "route layers" may have to be reserved for air liners only. In approving new designs a minimum arc of vision from the pilot's cockpit may have to be insisted on. Subject to a few reasonable restrictions of this sort the risks are not unreasonable. After all, the sky is a very big place, and quite limited portions of it are at present being used simultaneously by a hundred times the number of aircraft likely to occupy it under peacetime conditions.

To sum up, I believe that as soon as possible after the war is over, parent manufacturers should be given the opportunity to take back existing Government stocks of their own types of light and medium-light aircraft suitable for civil use, to be resold at the cost of reconditioning and modification with an agreed maximum figure for each type of aircraft (probably about one-sixth of its original manufactured price). Manufacturers would then inspect the aircraft to decide whether in each case the aircraft could be reconditioned, modified and sold within the maximum price limit; those which were rejected on these grounds or which were surplus to the manufacturers' estimate of market requirements could be scrapped or otherwise dealt with at the Government's discretion. Sales by manufacturers should be permitted in any part of the Empire and possibly extended to the territories of Allied nations with their consent. Restrictions on resale by a purchaser would be necessary to protect the interests of manufacturers, but these could be devised without undue difficulty. Restrictions on use should only be in accordance with normal air navigation and airworthiness regulations in force.



Budd twin-engined, welded stainless-steel cargo transport now in quantity production for the U.S. Navy. Ramp lowered for loading an ambulance through the underbody hatch.

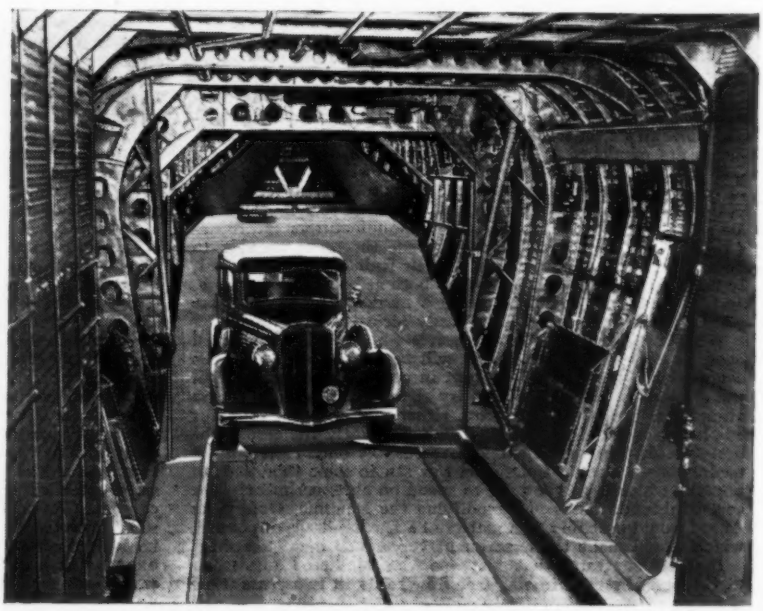
Budd Conestoga

A Welded Stainless-steel Cargo Plane

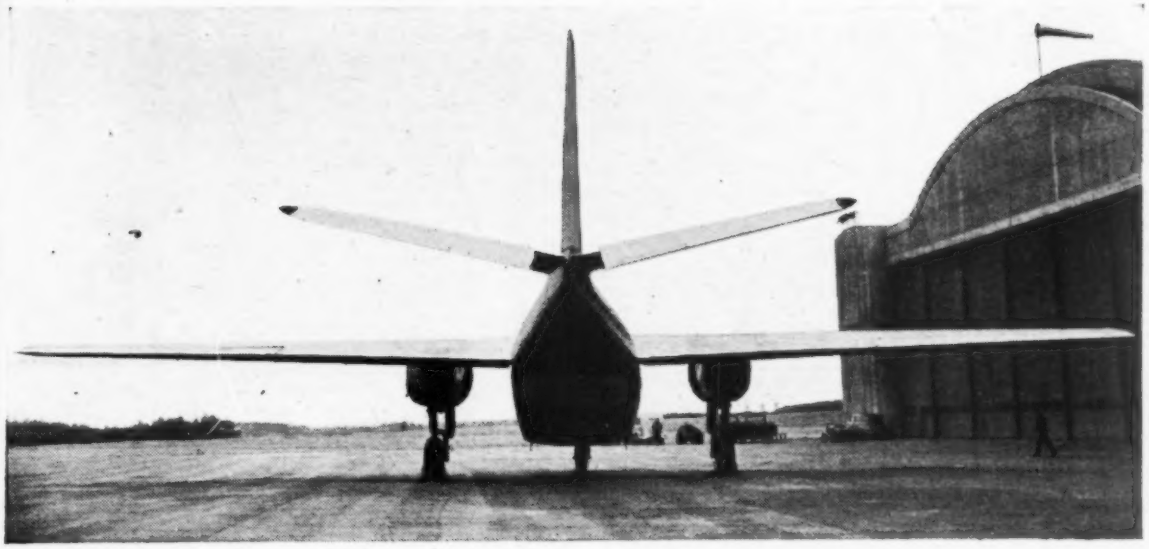
By H. W. PERRY

ONE of the many well-kept military secrets in the United States has been the designing and building of a very unconventional cargo transport for the Navy. The first authorisation to tell the story and publish pictures of the new craft was given quite recently. This new machine is built of stainless steel, welded instead of riveted, and was designed by the engineering staff of the Edward G. Budd Mfg. Co., of Philadelphia, under direction of Dr. Michael Watter and the sponsorship of the Navy Department Bureau of Aeronautics.

The machine was designed primarily for use on air routes in South America, where airfields are unimproved and short runways are common, but since the prototype was completed and tested, the military services plan to use duplicates on air cargo routes in nearly all theatres of the war. Quantity production is under way in a new Government-financed aircraft plant on the outskirts of Philadelphia. Neither the details of design, methods of production, nor the number to be built can be revealed at present, but that the number planned is large is indicated by the size of the assembly building alone. This is 1,800ft. long, 550ft. wide, and covers 24½ acres of land, while the property of the new plant as a whole embraces an area of 557 acres. Each of two assembly bays, 122ft. wide and 64ft. high, is designed to accommodate



Interior of the cargo compartment looking rearward, showing the loading ramp (partly raised) and the underbody doors raised to give full 8ft. headroom for loading large motorised equipment



Rear view of the Conestoga, showing the high-wing design, the boat-shaped fuselage, and, indistinctly, the rear loading hatch forward of and below the tail section.

a line of 26 machines in process of final erection.

This novel cargo aircraft has been given the official name *Conestoga,* as a tribute to the many hundreds of sturdy covered waggons of a type originated in Conestoga, New York State, and known as "Conestoga wagons," in which pioneer families of a century and more ago trekked westward to settle the free lands of the great Middle West and Far West. It is the second Budd-built stainless-steel aircraft, the first ever fabricated of this alloy having been built experimentally in 1931, successfully test flown the following year, then taken on a demonstration tour in Europe, and for the last eight years displayed out of doors under all weather conditions in front of the Franklin Institute in Philadelphia.

Design of the Conestoga was concentrated on the problem of creating a machine that would be capable of carrying goods economically on a non-stop flying range of moderate length, and have provision for loading and discharging cargo with maximum ease and speed. These objectives account for most of the unconventional design. The Navy accepted the design in 1942, made a contract with the company for its manufacture in August of that year, and the initial test flight of the prototype was made on the last day of October, 1943.

Size and Performance

The ship has a wing span of 100ft., an overall length of 68ft., and is powered with two 14-cylinder radial air-cooled engines of 1,200 h.p. each for take-off and a normal cruising rating of 1,050 h.p. With full load, the craft weighs 33,800 lb., of which 10,400 lb. is represented by cargo—an unusually high payload/total weight ratio. At a cruising speed of about 165 m.p.h. with full load (including equipment, fuel and crew) the engines are called upon to deliver only 719 h.p. each, making the rate of fuel consumption exceptionally low; the range exceeds 600 miles. If the built-in fuel tank capacity is fully utilised, the range will be about 1,700 miles, which can be doubled by fitting auxiliary tanks. Tests have shown that the payload of 10,400 lb. can be lifted off a landing strip in normal operation after only a short run.

The most distinguishing feature of the Conestoga, apart from the type of construction and the unconventional appearance, is the provision made for loading, carrying and unloading cargo. Upward sweep of the after section of the fuselage and the tail structure provides large clearance for loading and discharging cargo through an underneath hatch. This hatch is closed during flight by a hinged door, which can be lowered either to the ground or to the platform of a truck to serve as a ramp. To the rear of the hatch are two large clearance doors in the underbody which can be lifted to make sufficient headroom so that the full 8ft.-square section of the interior cargo compartment can be utilised.

Above the ramp is a specially designed hoist, and at the forward end of the cargo compartment is a winch to be operated manually for loading large, heavy pieces of freight, machinery or motor transport vehicles. Both a motor ambulance and a jeep can be rolled into the cargo compartment and leave space enough for stowing small items of cargo. Design of the aircraft and the fitting of a tricycle undercarriage keep the floor of the fuselage horizontal when the aircraft is on the ground and also when it is in flying attitude. So all loading can be done on the level from platforms of highway vehicles, obviating the need of hauling cases of goods up an inclined ramp and floor for stowage.

The long, unobstructed, 8ft.-square cargo compartment was made possible by attaching the wings of the craft to a series of five special frames joined across the fuselage by shallow but rigid transverse members instead of continuing the wing spars through the fuselage. This construction affords a headroom clearance of 8ft. through the length of the space.

Foreseeing that the Conestoga would be called upon to transport troops and evacuate wounded and sick servicemen, the designers made provision for installing 24 seats and 24 stretchers and also designed large doors on opposite sides of the bulbous nose of the ship. These doors will enable paratroops to jump simultaneously from both sides for quick concentration of a large force in a small area. Arrangement was made, too, for discharging equipment and supplies by parachute through the clearance doors back of the loading ramp, which may be done at the same time the paratroops are leaping from the forward side doors.

Only a crew of two, pilot and co-pilot, is needed to fly the Conestoga. Special attention was given to designing full-height, spacious and comfortable quarters for them in the nose, where dual controls, remote-control radio and facilities for blind-landing and take-off are installed.

One of the chief objectives of the engineers was to design an aircraft of the power and weight of the Conestoga which would have such good flying characteristics that it could be flown by pilots of only limited experience.

The builders expect that this novel craft will have a strong influence on commercial operation.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

EXHAUST-DRIVEN TURBINES
Possible but Impracticable

IN response to F. C. Roberts' article in July 6th issue, I should like to say that, in my opinion (for what it's worth), the idea, though possible, would be very impracticable. In the first place, power obtained from direct use of exhaust gases is not free; it causes back-pressure and therefore subsequent power loss at the crankshaft, so that to use them as pneumatic pressure is out of the question.

Further difficulty would be that of high temperatures, requiring special metals and insulating materials. Turbines (still crankshaft loss), for efficient conversion to mechanical energy, require to run at very high speeds (the smaller the turbine the greater the speed), and would therefore need complicated reduction gear to operate such slow-moving parts as pitch change, flaps and undercarriage.

Last but not least is the unfortunate circumstance that, coming in to land when undercarriage and flaps are needed, the engine is throttled back. K. V. P.

AIRCRAFT ENGINEERING TRAINING
Duplication to be Avoided

I QUITE agree with the letter of your correspondent B. Bernard (*Flight*, June 29th).

We have everything we need in our Empire for the first-class training of all our flying and ground personnel, so it is difficult to understand why the technicians of the S.B.A.C. ignore completely the big engineering training schools of the R.A.F. Surely it would be a waste of time and of money for the aeronautical private industry to duplicate them. The only essential job of the aircraft firms, when this war is over, will be to give us aircraft of all kinds such as can compete ably with the best in the world. And I, for one, am quite sure that our aircraft industry will be able to do this only with State assistance, however disguised that assistance may be.

So let the R.A.F. schools, whose high efficiency is recognised even by the most die-hard individualist if he be well informed, train for the R.A.F. and the private industry all the skilled tradesmen they will need. O. CLAYTON.

JET PROPULSION FOR AIRCRAFT
Balanced Forces and Thrust Augmentors

THE letters from Messrs. L. Shelford Bidwell and A. R. Billigheimer in your issues of June 15th and July 6th raise some very interesting points about which I should like to make some observations.

Taking the former correspondent's criticism first, I should like to say that my explanation of jet propulsion was, as pointed out by him, essentially for beginners and not for experts, hence the drastic simplification. He is quite right when he says that, strictly speaking, there is no unbalanced force, but I do not think that the balancing force is the one he suggests. The pressure on the area corresponding to the hole is the pressure in the gas which is due to the momentum of the molecules of the gas. The molecules are already moving and do not require to be accelerated.

What happens is that when the hole is presented to them, the random motion is converted into a more or less linear motion through the hole by a process (e.g., by bouncing off the walls) which it is needless to go into here. In effect he has taken the pressure in the gas and balanced it against itself. Actually what balances the pressure is the reaction of the wall of the box, which is due to the reaction of the support if the box is fixed or, if it is free to move, the reaction due to its acceleration, i.e. (mass of box) × (acceleration of box).

I agree with the statement that the pressure in the box is not uniform. I introduced this simplification intentionally because the pressure relations in the box are very complicated. If a calculation is made, assuming a constant pressure in the box, it will be found that the total thrust is much less than is obtained in practice. This is because the pressure on the portion surrounding the hole is less than that on the corresponding portion opposite it due to the drop in pressure accompanying the efflux of the gases from the hole. I leave this here because it is of little value to pursue this aspect of the matter.

I think there is a misconception about the speed at which a gas can issue from an orifice. If your correspondent consults a good work on thermodynamics or steam turbines he will find that the maximum velocity at which a gas can issue from a parallel-sided or converging orifice is at the speed of sound in the gas at the temperature and pressure of the gas at the orifice. Higher velocities can be obtained only by using a divergent nozzle, e.g., the Laval nozzle, such as is used on some steam turbines.

An increase of velocity in a divergent nozzle is obtained, of course, only when the pressure in the nozzle exceeds the pressure at the exit. In a divergent nozzle a drop of velocity is obtained when the pressure in the nozzle reaches exit pressure. As long as the pressure is above this the gases can expand and therefore increase their velocity.

It may be useful to remember that in jet propulsion we deal usually with gases moving at supersonic velocities and the ordinary laws of hydraulics have to be modified somewhat. He is, however, quite right in drawing attention to the possibility of the stream of gases not touching the sides in a divergent nozzle. The angle of divergence and shape of the nozzle have to be carefully chosen to avoid this, because if the divergence is too large practically no thrust is obtained in spite of the apparent increase in velocity of the gases.

As in the combustion chamber, so also in the divergent nozzle; unless the random momentum of the molecules is changed into a momentum directed along the axis of the nozzle by the molecules bouncing off the wall, no thrust will be obtained. In other words, there must be a pressure on the wall of the divergent nozzle inside it above that outside it if a thrust is to be obtained.

The thrust augmentor never fails to raise interest, and some lively discussions have taken place in the past about it. Your second correspondent has also tackled the problem, and I should like to deal with the points they raise at the same time.

All the tests on thrust augmentors of which I am aware have been made on static or comparatively slowly moving apparatus. A thrust augmentor moving at high velocity through the air needs a separate and largely experimental treatment. It would need to be properly streamlined to remove the "hour-glass" shape to which your first correspondent objects. It is simpler at this stage to deal with a static thrust augmentor.

Mr. Billigheimer says that the extra thrust actually obtained cannot be accounted for by the suction at the intake. I agree that this is so, but only in the case of a wrongly designed nozzle. In order to get a thrust from the divergent portion of the thrust augmentor there must be in it a pressure greater than atmospheric. This can be obtained only if the gases issue from the nozzle with a considerable excess pressure. I maintain that it is better to utilise this pressure in an extension of the nozzle itself rather than by putting an extra length on the thrust augmentor.

In the ideal case the gases issue from the nozzle at atmospheric pressure, and if they are discharged into a thrust augmentor the pressure cannot rise above atmospheric and therefore no thrust can be obtained. I think that he will find, if he re-examines the experiments he has in mind, that the gases issued from the jet motor at a pressure very much higher than atmospheric. In a properly designed combination the only extra thrust obtainable, that I can visualise, is from the suction at the intake. It comes down to this; that thrust augmentors are not really worth while, as I indicated in my letter. If your correspondent can prove otherwise I should be very glad to see the proof.

In a thrust augmentor, the fact that a large mass of air is being moved does not mean straightaway that an extra thrust on the equipment will be obtained. When a jet motor discharges into the atmosphere it shifts about a lot of air but no thrust is obtained from this. It is very necessary to examine where and how the thrust acts, otherwise the calculations of thrust are likely to be quite inaccurate.

May I, in conclusion, mention a small point which is likely to be forgotten in calculations of what a thrust augmentor can do? The velocity of the air at any portion of the intake cannot exceed the velocity of sound, and since the area of the throat is strictly limited the mass of air which can be drawn in is also very strictly limited. E. BURKE.

FREMO
ENGINEERS KEYS
ACCURATELY MACHINED.
FREDK MOUNTFORD LTD FREMO WORKS, BIRMINGHAM 5.

WHEREVER MEN FLY

Reid & Sigrist

FINE PRECISION INSTRUMENTS

REID & SIGRIST LTD., SHANNON CORNER, KINGSTON BY-PASS, NEW MALDEN

SEAFIRE'S SHADOW: A Seafire on the point of leaving for a patrol from the deck of H.M.S. *Illustrious*.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News and Announcements

A.E.A.F. High Command

Air Vice-Marshal E. P. WIGGLESWORTH, C.B., C.B.E., D.S.C., as Senior Air Staff Officer, Allied Expeditionary Air Force.

Air Vice-Marshal Wigglesworth was Deputy Air C.-in-C., Mediterranean Air Command under Sir Arthur Tedder from February, 1943. He was previously Senior Air Staff Officer, Headquarters, Middle East (1941), where he had been engaged since 1939 on Air Staff planning duties, and in November, 1942, was appointed A.O.C., East Africa.

Air Vice-Marshal J. B. COLE-HAMILTON, C.B., C.B.E., as Group Commander in Allied Expeditionary Air Force.

Air Vice-Marshal Cole-Hamilton was appointed A.O.C., Headquarters, West Africa, in November, 1943. He was previously A.O.C. Northern Ireland (1941), and in 1940 was A.O.C. of a training group.

Air Vice-Marshal L. O. BROWN, C.B.E., D.S.C., A.F.C., as Group Commander in Allied Expeditionary Air Force.

In June, 1943, Air Vice-Marshal Brown was appointed Air Officer in charge of Training at Headquarters, Fighter Command. He was previously Air Officer Commanding, H.Q., Palestine and Transjordan (1941), and at the outbreak of war was Senior Air Staff Officer of a bomber group in the Middle East.

Air Vice-Marshal B. E. EMBRY, D.S.O., A.F.C., as Group Commander in Allied Expeditionary Air Force.

Air Vice-Marshal Embry was appointed Senior Air Staff Officer of a Group in Fighter Command in January, 1943, before being appointed to command a group in Bomber Command. Earlier he was at H.Q. Fighter Command, and was S.A.S.O., Western Desert, in 1941.

Air Vice-Marshal H. BROADHURST, D.S.O., D.F.C., A.F.C., Group Commander in Allied Expeditionary Air Force.

Appointed A.O.C., Desert Air Force, in January, 1943, after being Senior Air Staff Officer for three months, Air Vice-Marshal Broadhurst is one of the youngest of his rank in the R.A.F.

Appointments

Air Comdre. L. TAYLOR, as Chief Maintenance Staff Officer, Headquarters, Middle East.

Air Comdre. F. E. VERNON, O.B.E., as Air Officer Commanding a Maintenance Group, Middle East Command.

Air Comdre. F. J. FRESSANGE, as Air Officer Commanding a Transport Command Wing.

Air Comdre. P. SLOCOMBE, as Deputy Chief Maintenance Officer, Headquarters, Mediterranean Allied Air Forces.

Air Comdre. K. B. B. CROSS, C.B.E., D.S.O., D.F.C., as Director of Overseas Operations at the Air Ministry.

Air Comdre. J. N. BOOTHMAN, C.B., D.F.C., A.F.C., as Commander of the Aeroplane and Armament Experimental Establishment.

The Rev. W. R. MARSH, B.D., Staff Chaplain, R.A.F., as an Honorary Chaplain to the King.

The King decorating Cpl. V. L. Maynard with the B.E.M., during a visit to a heavy bomber station.

Promotions

GENERAL DUTIES BRANCH.

Air Commodores (temp.) (Act. Air Vice-Marshals) are granted the rank of Air Commodores (war subs.), June 1st, 1944.

R. A. GEORGE, C.B.E., M.C.

L. O. BROWN, C.B.E., D.S.C., A.F.C.

Awards

Fleet Air Arm

THE KING has been graciously pleased to approve the following awards:—

For undaunted courage, resolution and skill while operating from H.M. Ships *Emperor*, *Searcher* and *Furious* in air attacks on enemy shipping in Northern waters:—

Bar to Distinguished Service Cross

Temp. Lt. (A) B. RITCHIE, D.S.C., R.N.V.R.

Distinguished Service Cross

Temp. Sub. Lt. (A) J. G. DEVITT, R.N.V.R.

For bravery in attempting to save life at sea:—

Albert Medal

Temp. Sub. Lt. (A) G. McHARDY, R.N.V.R., and Sick Berth Attendant I. T. GRIFFITHS.

When an aircraft crashed while landing on H.M.S. *Illustrious* and came to rest with the engine on the flight deck and the tail on top of a pom-pom gun, petrol began to pour from the wreck, and within two minutes an explosion was followed by fire. Within those two minutes Sub. Ltd. McHardy, who had himself only just landed on, and Sick Berth Attendant Griffiths, who was a member of a party detailed for medical duties on the flight deck, climbed on to the aircraft in an attempt to free the pilot, although both were well aware of the extreme risk they were running. They were killed by the explosion that followed.

Royal Air Force

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

Distinguished Service Order

Act. Wing Cdr. D. S. S. WILKERSON, D.F.C., R.A.F.V.R., No. 578 Sqn.—This officer has completed many sorties on his second tour of operations. He has displayed high powers of leadership, great skill and determination, qualities which have earned him much success. He is a devoted and zealous squadron commander, whose great drive and tactical ability have contributed in large measure to the high standard of operational efficiency of the squadron.

Bar to Distinguished Flying Cross

Flt. Lt. E. A. HOLDAWAY, D.F.C., R.N.Z.A.F., No. 139 Sqn.—As pilot and navigator respectively these officers have completed a large number of sorties, including attacks on such well defended targets as Berlin, Hamburg, and centres in the Ruhr area. They have invariably displayed great skill, courage and resolution, qualities which were well in evidence during a recent sortie against the German capital. Whilst over the North Sea a severe storm was encountered, but Flt. Lt. Holdaway flew through it and on to the enemy coast. Whilst over the target the aircraft was hit by shrapnel and one engine was rendered useless. Nevertheless, Flt. Lt. Holdaway flew the damaged aircraft to a home-based airfield. On the return flight, F/O. Lloyd, although deprived of the use of some of his instruments, navigated the aircraft with his usual skill and initiative. This is the second occasion within recent weeks in which they completed their mission with one engine out of action. Their achievements have been worthy of much praise.

Act. Sqn. Ldr. G. J. BLACK, D.F.C., R.A.F.V.R., No. 250 Sqn.—This officer has taken part in many sorties since being awarded the D.F.C., and has displayed great skill and dash throughout. In April, 1944, he led the squadron on a reconnaissance during which an airfield in the Rieti area was attacked. In spite of light anti-aircraft fire the attack was well pressed home and eleven aircraft on the ground were set on fire. Sqn. Ldr. Black's gallant and skilful leadership played a good part in the success achieved.

Act. Flt. Lt. A. C. SHIPWAY, D.F.C., R.A.F.V.R., No. 83 Sqn.—Since being awarded the D.F.C., Flt. Lt. Shipway has made numerous attacks on German targets with outstanding success. As a captain of aircraft he has always flown with conspicuous gallantry and skill, pressing home his attacks with great determination, regardless of heavy enemy opposition.

Act. Flt. Lt. L. H. TOLCHARD, D.F.C., R.A.F.V.R., No. 83 Sqn.—As a captain of a heavy bomber, this officer has participated in a large number of sorties against major targets in Germany. Since the award of the D.F.C., he has maintained the high standard of efficiency previously attained by his crew, and has always displayed the greatest eagerness to undertake his allotted tasks. His determination and courage have been most commendable.

Act. Wing Cdr. J. D. PATTISON, D.F.C., R.C.A.F., No. 429 (R.C.A.F.) Sqn.—Wing Cdr. Pattison, now on his second tour of operational duty, has a long and distinguished record of operational flying. Since being awarded the D.F.C. he has completed many further sorties, all of which have been against important and strongly defended German targets. An excellent squadron commander, he has always set a splendid example of determination and skill, coupled with a fine fighting spirit.

Act. Sqn. Ldr. H. GOWAN, D.F.C., R.C.A.F., No. 405 (R.C.A.F.) Sqn.—Sqn. Ldr. Gowan has completed two tours of operational duty. He has attacked some of the enemy's most heavily defended targets, including Berlin, Cologne and Hanover. At all times he has displayed courage, skill and determination of a high order. An exceptional pilot and organiser, he has played no small part in the successes achieved by his squadron.

Distinguished Flying Cross

F/O. D. A. LLOYD, D.F.M., R.A.F.V.R., No. 139 Sqn.—For citation see Flt. Lt. Holdaway, D.F.C. and Bar.

Act. Sqn. Ldr. J. W. E. TYLER, R.A.F.V.R., No. 434 (R.C.A.F.) Sqn.

Act. Flt. Lt. G. A. BERRY, R.C.A.F., No. 61 Sqn.

Act. Flt. Lt. G. G. EMPEY, R.C.A.F., No. 115 Sqn.

Act. Flt. Lt. E. J. C. GUTHRIE, R.N.Z.A.F., No. 199 Sqn.

F/O. D. CURTIS, R.A.F.V.R., No. 248 Sqn.

F/O. J. P. FINNESSY, R.A.F.V.R., No. 172 Sqn.

F/O. R. H. PHILLIPS, R.A.F.V.R., No. 115 Sqn.

W/O. P. D. MITCHELL, D.F.M., R.C.A.F., No. 619 Sqn.

W/O. L. H. TOOD, R.C.A.F., No. 630 Sqn.

SERVICE AVIATION

Act. Sqn. Ldr. P. A. HUGHES, R.A.F., No. 489 (N.Z.) Sqn.

Act. Sqn. Ldr. R. A. KIPP, R.C.A.F., No. 418 (R.C.A.F.) Sqn.

Capt. T. R. J. TAYLOR, S.A.A.F., No. 93 Sqn.

F/O. B. BENT, R.A.F., No. 25 Sqn.

F/O. T. FLETCHER, D.F.M., R.A.F.V.R., No. 249 Sqn.

F/O. B. W. G. PELGATE, R.A.F.V.R., No. 166 Sqn.

F/O. W. G. HASLAM, No. 25 Sqn.

F/O. V. L. JACKSON, R.A.F., No. 150 Sqn.

Act. Sqn. Ldr. A. C. LAWSON, R.A.F., No. 23 Sqn.

Flt. Lt. A. BARKER, R.A.F.V.R., No. 255 Sqn.

Flt. Lt. C. V. BENNETT, R.A.F.V.R., No. 256 Sqn.

Flt. Lt. A. BROWN, R.A.F.V.R., No. 150 Sqn.

Flt. Lt. R. W. HILKEN, R.A.F.V.R., No. 600 Sqn.

Flt. Lt. J. F. NORTON, R.A.F.V.R., No. 241 Sqn.

Act. Flt. Lt. G. HAMPTON, R.A.F., No. 223 Sqn.

F/O. R. M. CARPENTER, R.A.F.V.R., No. 52 Sqn.

F/O. J. McG. JOHNSTONE, R.A.F.V.R., No. 142 Sqn.

W/O. S. J. HARROP, R.A.F.V.R., No. 600 Sqn.

Flt. Lt. E. C. HEY, R.A.A.F., No. 683 Sqn.

Act. Flt. Lt. R. A. BINT, R.A.A.F., No. 150 Sqn.

PAPER! Sqn. Ldr. The Rev. W. E. Clarke, the padre of a Mustang squadron, delivering newspapers to R.A.F. ground crews at dispersal points in Normandy.

F/O. B. J. O'CONNELL, R.A.A.F., No. 682 Sqn.

F/O. R. ROWE, R.A.A.F., No. 450 (R.A.A.F.) Sqn.

F/O. H. R. WINCHCOMBE, R.A.A.F., No. 37 Sqn.

P/O. S. S. M. TUNSTALL, R.A.A.F., No. 150 Sqn.

P/O. E. L. VIVEASH, R.A.A.F., No. 150 Sqn.

W/O. R. LATH, R.A.A.F., No. 40 Sqn.

Act. Flt. Lt. M. C. HYSLOP, R.C.A.F.

Act. Flt. Lt. B. J. INGALLS, R.C.A.F., No. 72 Sqn.

F/O. J. RITCHIE, R.C.A.F., No. 600 Sqn.

Flt. Lt. R. GOULD, R.N.Z.A.F., No. 241 Sqn.

W/O. T. A. GILLARD, R.N.Z.A.F., No. 450 (R.A.A.F.) Sqn.

W/O. D. A. HARKNESS, R.N.Z.A.F., No. 142 Sqn.

Capt. P. DAPHNE, S.A.A.F., No. 60 (S.A.A.F.) Sqn.

Lt. W. V. BRUNTON, S.A.A.F., No. 4 (S.A.A.F.) Sqn.

Lt. R. W. ROWAN, S.A.A.F., No. 4 (S.A.A.F.) Sqn.

Sqn. Ldr. H. B. RUSSELL, R.A.F.O., No. 164 Sqn.

Act. Sqn. Ldr. C. F. COUNTER, R.A.F.V.R., No. 261 Sqn.

Act. Sqn. Ldr. G. D. M. THOMAS, R.A.F.V.R., No. 294 Sqn.

Flt. Lt. L. H. DAWES, R.A.F.V.R., No. 607 Sqn.

Flt. Lt. L. H. HODDER, R.A.F.V.R., No. 605 Sqn.

Flt. Lt. P. A. KNAPTON, R.A.F.V.R., No. 134 Sqn.

Flt. Lt. D. B. F. NICHOLLS, R.A.F.V.R., No. 258 Sqn.

Flt. Lt. V. D. PAGE, R.A.F.V.R., No. 11 Sqn.

Flt. Lt. M. G. RIDLEY-MARTIN, R.A.F.V.R., No. 170 Sqn.

Flt. Lt. R. W. F. SAMPSON, R.A.F.V.R., No. 131 Sqn.

F/O. E. W. SIMKINS, R.A.F.V.R., No. 88 Sqn.

F/O. A. P. EYTON-JONES, R.A.F.V.R., No. 21 Sqn.

P/O. J. TEMPLETON, R.A.F.V.R., No. 227 Sqn.

Flt. Lt. D. K. MCDONALD, R.A.A.F., No. 261 Sqn.

Flt. Lt. R. R. SANDERSON, R.A.A.F., No. 168 Sqn.

Flt. Lt. F. E. WILSON, R.A.A.F., No. 277 Sqn.

Act. Sqn. Ldr. C. H. STOVER, R.C.A.F., No. 414 Sqn.

Flt. Lt. G. W. BURROUGHS, R.C.A.F., No. 414 Sqn.

Act. Flt. Lt. R. G. MIDDLEMISS, R.C.A.F., No. 403 (R.C.A.F.) Sqn.

Act. Flt. Lt. G. A. MUIR, R.C.A.F., No. 46 Sqn.

Flt. Lt. N. L. PARRY, R.N.Z.A.F., No. 681 Sqn.

Act. Flt. Lt. R. J. DALL, R.N.Z.A.F., No. 198 Sqn.

F/O. G. A. M. STRUTHERS, R.N.Z.A.F., No. 180 Son.

P/O. D. A. WADSWORTH, R.A.F.V.R., No. 619 Sqn.

Flt. Lt. J. W. SANDILANDS, R.A.A.F. (since deceased), No. 82 Sqn.

Flt. Lt. A. P. WILLS, R.A.F.V.R., No. 177 Sqn.

Maj. M. G. HOWSON, S.A.A.F., No. 15 (S.A.A.F.) Sqn.

Flt. Lt. J. R. HAMPSON, R.A.F.V.R., No. 105 Sqn.

P/O. G. W. KELLY, R.A.F.V.R.

Flt. Lt. A. F. FORSDIKE, R.A.F.V.R., No. 158 Sqn.

Flt. Lt. J. N. REYNOLDS, R.A.F.V.R., No. 158 Sqn.

Act. Flt. Lt. T. NEISON, R.A.F.V.R., No. 630 Sqn.

F/O. D. R. COURAGE, R.A.A.F., No. 158 Sqn.

F/O. J. A. C. KENNEDY, R.A.A.F., No. 467 (R.A.A.F.) Sqn.

F/O. W. A. LENNARD, R.A.F.V.R., No. 158 Sqn.

F/O. D. F. WARD, R.A.A.F., No. 463 (R.A.A.F.) Sqn.

P/O. S. DALE, R.A.F.V.R., No. 158 Sqn.

P/O. R. C. HOOPER, R.A.F.V.R., No. 630 Sqn.

P/O. R. J. SCAMMELL, R.A.F.V.R., No. 218 Sqn.

P/O. J. WISBEY, R.A.F.V.R., No. 640 Sqn.

P/O. L. HUNT, R.A.F.V.R., No. 166 Sqn.

Wing Cdr. J. R. JEUDWINE, O.B.E., R.A.F., No. 619 Sqn.

Act. Wing Cdr. J. F. GREY, R.A.F.O., No. 207 Sqn.

Act. Flt. Lt. S. L. BENNETT, R.A.F.V.R., No. 78 Sqn.

Act. Flt. Lt. D. BROWN, R.A.F.V.R., No. 433 (R.C.A.F.) Sqn.

Act. Flt. Lt. B. S. DOWNS, R.A.F.V.R., No. 78 Sqn.

Act. Flt. Lt. E. A. MCGREGOR, R.A.A.F., No. 78 Sqn.

F/O. T. C. COOKE, R.C.A.F., No. 162 Sqn.

F/O. B. E. WILMOT, R.C.A.F., No. 425 (R.C.A.F.) Sqn.

P/O. W. A. STRATIS, R.A.F.V.R., No. 44 Sqn.

THE KING has been graciously pleased to approve the following award with effect from May 16th, 1944, in recognition of gallantry displayed in flying operations against the enemy in the South-West Pacific:

Distinguished Flying Cross

F/O. F. MUSSON, R.A.A.F.

Conspicuous Gallantry Medal (Flying)

W/O. W. G. BICKLEY, R.A.F., No. 617 Sqn.—As air gunner, W/O. Bickley has completed a very large number of sorties, many of them calling for a high degree of courage and resolution. His appreciation of the responsibilities entrusted to him and his determination to achieve success have been a notable feature of his service. His great gallantry and fine fighting qualities have set an example in keeping with the best traditions of the Royal Air Force.

Distinguished Flying Medal

Flt. Sgt. K. L. SUMNER, R.A.F.V.R., No. 44 Sqn.

Sgt. F. H. JOY, R.A.F.V.R., No. 619 Sqn.

Sgt. J. H. MALTBY, R.A.F.V.R., No. 619 Sqn.

Sgt. M. W. SAUNDERS, R.A.F.V.R., No. 166 Sqn.

Flt. Sgt. (now W/O.) K. J. DUNMALL, R.A.F.V.R., No 75 (N.Z.) Sqn.

Flt. Sgt. K. R. MEAD, R.A.F.V.R., No. 236 Sqn.

Flt. Sgt. A. W. GIBSON, R.N.Z.A.F., No. 166 Sqn.

Sgt. A. BOWDEN, R.A.F.V.R., No. 166 Sqn.

Sgt. E. H. HAMLYN, R.A.F.V.R., No. 78 Sqn.

Sgt. J. MURRAY, R.A.F., No. 101 Sqn.

Sgt. E. OWEN, R.A.F.V.R., No. 103 Sqn.

Sgt. J. RUSSELL, R.A.F.V.R., No. 51 Sqn.

Sgt. J. G. SERVICE, R.A.F.V.R., No. 51 Sqn.

Sgt. J. H. TURNER, R.A.F.V.R., No. 9 Sqn.

Flt. Sgt. M. G. PRICE, R.C.A.F., No. 49 Sqn.

Flt. Sgt. (now W/O.) C. P. E. STEEDSMAN, R.C.A.F., No. 61 Sqn.

Flt. Sgt. A. L. B. CARSON, R.N.Z.A.F., No. 7 Sqn. (since deceased).

THE KING has been graciously pleased to approve the following award:—

B.E.M. (Mil.)

LA/C. P. G. PETERSEN, R.N.Z.A.F.

SERVICE AVIATION

Foreign Decoration

THE KING has granted unrestricted permission for the wearing of the undermentioned decoration conferred upon the officer indicated in recognition of valuable services rendered in connection with the war:—

Conferred by the President of the Republic of Poland

Virtuti Militari (5th Class)

Flt. Lt. M. O'DONOVAN, R.A.F.V.R.

Roll of Honour

Casualty Communiqué No. 404.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 105 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—F/O. J. F. Banister; F/O. J. H. Silvester.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. J. Affleck; Sgt. A. E. Belshaw; Sgt. T. Davies; Sgt. N. T. Harris; Sgt. R. Hunter; Sgt. L. Letts; Sgt. J. H. Naylor; Sgt. C. Walton; Flt. Sgt. R. A. Zahl.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. J. H. Baily; Sgt. E. G. W. Bartlett; Sgt. G. H. Beck; Sgt. W. J. Beggs; Sgt. E. J. Bell; W/O. M. R. Braines; F/O. J. R. Brice; Sgt. C. F. Brown; Sgt. V. F. Burnett; Sgt. C. Button; Sgt. S. W. Chapman; Sgt. L. G. Chesson; Sgt. A. V. E. Cobby; Flt. Sgt. J. M. Cummings; Sgt. J. Cunningham; P/O. R. Ellis; Sgt. J. Fleming; Sgt. R. Gibson; Sgt. E. D. Giles; Sgt. E. E. Greenfield; P/O. P. Hartstein; Sgt. V. B. Hawkins; P/O. S. D. Hopkin; Act. Flt. Lt. R. R. Howgill; Sgt. E. Kempson; Sgt. C. H. Leech; P/O. W. C. Liebermann; Flt. Sgt. J. W. Low; Sgt. R. G. Martin; Sgt. K. P. Middleton; Sgt. A. Millican; Act. Flt. Lt. E. W. Mitchell, D.F.C.; P/O. V. G. Muddell; Sgt. K. J. Offer; P/O. R. E. Olive; Sgt. R. L. Pasquine; Wing Cdr. W. M. Penman, D.F.C., A.F.C.; Sgt. L. A. H. Petts; P/O. A. A. Pottinger; P/O. J. A. Robertson; P/O. Root-Reid; Flt. Sgt. N. Rosenblatt; F/O. P. Shepherd-Smith; Flt. Sgt. A. R. Smith; Flt. Sgt. W. H. Smitham; Sgt. S. D. Stait; Sgt. C. C. Stenning; P/O. G. N. Stephenson; P/O. K. J. Stephenson; Sgt. J. H. Stevens; Sgt. T. F. Stott; P/O. F. H. Thacker; Act. Flt. Lt. D. L. Thomson; Flt. Lt. J. S. Watt, D.S.O., D.F.C.; Sgt. W. A. Whalley; Sgt. H. Wharton; Act. Flt. Lt. D. A. C. Wilkinson, B.E.M.; Sgt. S. J. Wilson.

WOUNDED OR INJURED IN ACTION.—Sgt. J. G. Killikelly.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. W. E. Cocks; F/O. R. H. Cond; W/O. J. D. Cook; Sgt. J. F. Garnett; Sgt. A. L. Hewitt; Act. Sqn. Ldr. I. A. Morris; P/O. C. C. Sykes.

MISSING.—Sgt. L. R. Adams; Sgt. O'N. G. Adams; Sgt. W. J. Anstey; Sgt. A. W. W. Ayres; Flt. Lt. F. S. Barnsdale; Sgt. W. J. Batchouski; Flt. Sgt. R. C. J. Berry; F/O. D. L. Biggs; Sgt. W. Bingham; Sgt. J. S. Bolton; Sgt. R. Brimelow; Flt. Sgt. T. H. Caldecutt; Sgt. F. J. Castle; Sgt. C. Clamp; P/O. F. Clark; Sgt. J. Cochrane; Sgt. T. R. Connatty; Flt. Sgt. R. Cowley; Sgt. C. H. Crosbie; Sgt. H. McL. Donnelly; Sgt. J. H. Dunn; F/O. J. R. Dyer; Sgt. E. C. Edwards; F/O. G. Elmy; F/O. N. J. Fairbairn; Sgt. E. Finlay; Sgt. P. Furlong; F/O. A. J. Gapper; Sgt. K. Gardiner; Sgt. F. Heath; Flt. Sgt. C. R. Hitchcock; Flt. Lt. K. C. Hoad; Sgt. V. S. Holloway; Flt. Sgt. F. W. Hubbard; F/O. W. K. James; Act. F/O. A. Jameson; P/O. S. A. Jeapes; P/O. P. Kettles-Roy; Flt. Sgt. H. A. King; Sgt. A. F. Kneller; Sgt. L. Lanaghan; Sgt. W. Lane; F/O. F. S. Langston; Sgt. K. Lawry; Sgt. H. E. Lees; Sgt. W. A. Littlewood; Flt. Sgt. W. E. Lock; Sgt. S. McConnell; Flt. Sgt. G. McEwan; Sgt. A. Maclean; Sgt. M. Madden; F/O. J. B. Marshall; Flt. Sgt. C. H. T. Martin; F/O. A. H. Milward; Flt. Sgt. R. S. Moore; Sgt. G. M. Morris; Flt. Sgt. D. E. Moss; Sqn. Ldr. M. Negus; Sgt. J. Nicholl; Sgt. F. T. Nolan; Flt. Sgt. W. P. H. O'Neill; Flt. Sgt. E. E. J. Patmore; Sgt. W. C. Pearce; Sgt. G. G. Pemberton; Sgt. G. D. Phœnix; Sgt. J. Ramsay; Sgt. T. J. Rogers; Sgt. D. Rolfe; Sgt. F. Shaw; Sgt. D. Stewart; F/O. M. B. Strubell; Flt. Sgt. D. F. Stunt; Flt. Sgt. N. H. Sutton; F/O. P. G. Taylor; Sgt. J. Torode; Sgt. K. J. Turley; Flt. Sgt. K. R. Turner; F/O. H. Whitmill; Sgt. K. J. Willett; Sgt. F. Wilson; Flt. Sgt. J. E. Wood; Sgt. L. A. Wood; Sgt. L. H. Wyness.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—F/O. B. B. Gateley; Sgt. H. L. Regan; F/O. D. J. Simon.

KILLED ON ACTIVE SERVICE.—F/O. J. T. Agnew, D.F.C.; Sgt. H. B. Allan; F/O. J. A. Amy; Sgt. P. E. Andrews; Sgt. F. T. G. Atkins; Cpl. D. A. Bird; Flt. Sgt. H. B. Blackwell; Cpl. N. F. Brindley; Cpl. J. R. Caley; Sgt. F. Childs; F/O. R. Davison; F/O. W. T. Davy; P/O. D. R. Doyle; Sgt. F. N. Ellis; Sgt. E. G. Emsley; Sgt. R. M. Evre; L.A/C. G. R. Flisher; Sgt. D. Fretwell; Sgt. L. E. Garrod; F/O. H. R. Goddard; Sgt. F. Gradwell; Act. Sqn. Ldr. E. S. Harries; P/O. P. Henderson; P/O. M. A. W. Henley; Sgt. A. B. Hicklin; Sgt. J. M. Hindmarsh; Flt. Sgt. C. C. O. Hood; Sgt. A. J. Hutchings; Flt. Sgt. F. J. Ingram; Sgt. C. J. Jewell; F/O. D. H. King; Sgt. G. W. Lewis; Flt. Sgt. R. G. Lewis; Sgt. E. D. MacDonald; L.A/C. J. Mann; F/O. N. A. R. Mousdell; Sgt. I. Newbould; F/O. O. E. P. Newcater; Sgt. H. D. Purbrick; Sgt. H. Reavey; Sgt. C. H. Robinson; Sgt. L. Shaiman; L.A/C. D. R. Starkey; Sgt. H. S. N. Steel; Sgt. E. W. Tootill; W/O. W. A. Watson; Flt. Sgt. J. Watt; Flt. Sgt. E. C. Willard; L.A/C. T. G. Wooton.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. E. J. M. Albert; L.A/C. R. A. Bond; Sgt. W. J. Douglas; Sgt. P. Fox; Sgt. D. M. Gray; L.A/C. B. Hart; L.A/C. R. W. Johnson; L.A/C. J. Little; Flt. Sgt. A. P. Price; Sgt. W. A. Robinson; Sgt. S. A. Thornton; Sgt. J. J. Wemyss.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sqn. Ldr. P. R. Apellis; L.A/C. W. Bruce; Sgt. H. Cohen; L.A/C. T. Darby; Sgt. J. C. Elmer; A/C.2 T. N. McCart; Sgt. A. E. Miller; P/O. A. D. W. Moore; L.A/C. W. Musgrave; Sgt. R. L. Peaker; Flt. Sgt. H. H. Rushworth; F/O. H. E. Stone; L.A/C. J. Taylor; Sgt. J. Walton.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. B. P. Atkins; Flt. Lt. P. G. F. Brown; P/O. C. H. Cox.

DIED ON ACTIVE SERVICE.—Cpl. J. W. Armfield; A/C.2 H. E. Barnett; A/C.2 W. Carswell; Cpl. J. H. Cronk; L.A/C. R. M. Cummings; L.A/C. E. C. Dennis; Sgt. W. C. Dismore; L.A/C. C. Eastell; A/C.2 K. W. Howse; L.A/C. J. B. Kinder; F/O. G. W. Leefe; L.A/C. T. R. Litterick; L.A/C. E. W. Moore; Flt. Sgt. F. L. Parrott; A/C.1 A. L. Payne; Cpl. R. C. Shepherd; L.A/C. R. R. Ward; Cpl. H. C. Wilson.

ROME—BY AIR: Transport Command has now opened scheduled services to Rome. The photograph shows the crew of the first Dakota to arrive at the capital.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. F. Booth; L.A/CW. J. E. Dickinson; A/CW.1 D. Sparrow.

Royal Australian Air Force

KILLED IN ACTION.—Flt. Sgt. E. H. Traeger; Flt. Sgt. A. H. Wilson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. T. C. O'Sullivan; F/O. A. H. Reardon.

MISSING, BELIEVED KILLED IN ACTION.—P/O. E. T. Lynch; P/O. R. E. Yarra.

MISSING.—Flt. Sgt. D. C. Bates; Sgt. J. G. Beilby; Flt. Sgt. J. S. Boden; Flt. Sgt. E. Daniels; Flt. Sgt. K. R. Foster; Flt. Sgt. M. R. Goldney; W/O. F. E. James; F/O. K. W. Light, D.F.M.; Sgt. M. D. D. MacFarlane; Flt. Sgt. E. A. Nayler; Flt. Sgt. H. C. Redpath; Flt. Sgt. C. J. Schmidt; Flt. Sgt. W. G. Swanbury; Flt. Sgt. K. W. Webb; Flt. Sgt. E. Wilkins; Flt. Sgt. R. W. Wright.

KILLED ON ACTIVE SERVICE.—Flt. Lt. R. Agnew; Flt. Sgt. H. N. Burns; Flt. Lt. J. W. Sandilands.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. M. E. Curtois.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Lt. R. B. Smith.

DIED ON ACTIVE SERVICE.—P/O. H. G. Frew.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. R. S. Birks; Flt. Sgt. T. J. Driscoll; Sgt. C. Green; Flt. Sgt. J. S. Kelly; F/O. H. B. Parliament; F/O. C. R. Trery; P/O. D. A. Wood.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. R. J. Agar; W/O. A. G. Bailey; W/O. G. Bancescoe; P/O. G. R. Brown; F/O. S. Brown; P/O. C. J. Challenger; Flt. Sgt. J. Cooper; F/O. J. D. Erzinger; F/O. J. Harrington; F/O. M. W. Howard; Flt. Sgt. G. J. McEachern; F/O. D. M. Swanson.

MISSING.—Sgt. R. J. Atkins; W/O. N. Baker; Sgt. H. F. Bottomley; Sgt. A. J. Bradshaw; P/O. A. G. Campbell; W/O. A. H. Crossland; F/O. W. L. Cruse; Sgt. A. M. Dewitt; Sqn. Ldr. J. M. Dissett, D.F.M.; F/O. J. Doig; F/O. H. M. Elliott; Flt. Sgt. W. C. Hall; Flt. Sgt. C. R. Harnish; P/O. C. G. Leatherdale; F/O. J. H. G. G. Leclaire; Sgt. D. V. McIntyre; Flt. Sgt. P. L. Mitchell; F/O. G. E. Munro; F/O. R. A. Shannon, D.F.M.; W/O. J. J. H. Sheahan; Flt. Sgt. K. F. Shoener; Flt. Lt. J. R. Taylor; W/O. F. W. Topping; Flt. Sgt. G. D. Torbet; Flt. Sgt. J. G. Vaughan; F/O. R. J. White, D.F.M.; F/O. F. R. Zulauf, D.F.M.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—W/O. T. B. Hunter; Flt. Sgt. W. Stirling.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. L. B. Hewer; Sgt. E. R. Swindells.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. L. Chandler.

MISSING.—Flt. Lt. C. F. Benefield, D.F.C.; Flt. Sgt. L. N. Couchman; Act. Sqn. Ldr. B. M. Gilmour; P/O. W. J. Green.

KILLED ON ACTIVE SERVICE.—P/O. F. G. A. McJennett; F/O. H. C. Wilkie, D.F.C.

Casualty Communiqué No. 405

Of the names in this list, 90 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Sgt. G. J. Lewis; Sgt. J. E. Lowe; Sgt. K. L. MacFarlane; Flt. Sgt. J. J. G. Nicholson; Flt. Lt. J. R. Scott; Flt. Sgt. J. I. Shaer; Flt. Sgt. J. M. Wagstaffe; Flt. Sgt. R. H. Williamson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. G. Gourley; P/O. D. C. Neil; Flt. Sgt. E. L. Penington; F/O. A. O. Whapham.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. A. P. Arnott; P/O. C. P. Bailie; Sgt. E. C. A. Barnes; Sgt. J. W. Barrett; W/O. A. P. Bates; Sgt. C. B. Brown; Sgt. R. Carlon; Sgt. L. F. Comer; Sgt. T. L. Craven; Sgt. R. H. Crooks; Sgt. J. W. Cum-

SERVICE AVIATION

mings; Sgt. J. A. Currey; W/O. B. B. Davidson; Sgt. G. W. D. Dean; P/O. G. F. Disbury; Act. Flt. Sgt. L. A. Drummond; Sgt. L. J. Dugard; Sgt. L. W. Eade; Sgt. D. Easton; Sgt. L. English; Sgt. W. J. Forgan; Sgt. L. G. E. Gee; Sgt. J. H. Greaves; Sgt. J. Hamilton; F/O. K. Harrison; P/O. J. W. Heppell; Sgt. F. Hodson; Sgt. J. Hougham; F/O. W. Hughes; Sgt. E. F. Hunting; Sgt. J. Isherwood; Sgt. B. Jefferies; Flt. Sgt. H. N. Jones; Sgt. R. Jones; F/O. P. G. Keogh; Sgt. C. R. Langley; P/O. I. R. Lewis; Sgt. W. McGill; Sgt. E. Millward; Sgt. A. W. Monk; Sgt. E. G. Nickels; Sgt. J. H. O'Farrell; Sgt. F. G. Pryde; Sgt. T. Purdie; P/O. D. G. Scruton; Sgt. S. Sinclair; Sgt. L. G. Smart; Sgt. L. Spurgeon; Sgt. R. C. Walton.

WOUNDED OR INJURED IN ACTION.—F/O. R. Bullen; F/O. G. S. Forrest; Flt. Sgt. J. P. Grundy; F/O. A. R. Heckman; Flt. Sgt. H. W. Wood.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. H. D. Collershaw.

MISSING, BELIEVED KILLED IN ACTION.—F/O. R. J. Debenham; Flt. Sgt. R. S. D. Hatswell.

MISSING.—Sgt. C. T. Bishop; Flt. Sgt. D. N. Bishop; F/O. R. J. Bordiss; Sgt. T. H. Burke; F/O. J. J. K. Burr; Flt. Sgt. W. W. Campbell; Sgt. J. A. Chambers; Sgt. R. A. Chambers; Sgt. K. Clough; Sgt. F. Conroy; Flt. Sgt. P. P. Cowan; Sgt. A. Crook; Sgt. F. Dodd; Flt. Sgt. K. A. E. Draycott; Sgt. R. Duffy; Flt. Sgt. T. R. Dunlop; Flt. Sgt. P. J. Dunstan; Sgt. G. E. Dyckhoff; Sgt. R. G. P. B. Dyer; Sgt. S. Edwards; P/O. F. G. Gardiner; Flt. Sgt. F. J. H. Garrick; Sgt. C. R. Hanks; Sgt. T. Hardman; Flt. Sgt. W. N. Hartley; Sgt. T. Heslop; P/O. D. H. Hogg; Flt. Sgt. J. K. Hovell; F/O. F. B. James; F/O. W. L. Jarvis; P/O. D. Jefferies; Sgt. C. Jelley; Act. Sqn. Ldr. E. H. C. Kee; Sgt. C. R. Kemp; Sgt. J. M. Knott; Sgt. H. Lacey; F/O. N. T. Lawrence; F/O. F. V. Legon; Sgt. C. W. Lovell; Sgt. R. Lundy; Sgt. M. C. McCarthy; P/O. D. McGregor; Sgt. T. McKinstry; F/O. J. MacPherson; Sgt. L. Martin; F/O. W. G. Meeson; F/O. F. Miller; Sgt. S. H. Mills; Sgt. H. C. Munns; Sgt. S. G. Myers; Sgt. H. D. Nash; F/O. J. R. Normandale; Sgt. D. R. R. J. Pepall; Sgt. H. W. Pound; Sgt. A. W. Price; Sgt. J. M. Roberts; Sgt. J. Robertson; Sgt. J. G. Robson; Act. Flt. Lt. R. V. Sanders; Flt. Sgt. A. Sarjantson; Flt. Sgt. St. J. E. R. S. Scheffler; Sgt. C. J. Selby; Sgt. D. Shepherd; Sgt. F. G. Shields; Sgt. R. Smedley; Sgt. J. A. Smith; Sgt. E. H. Stedman; F/O. F. Stevens; F/O. A. Stewart; Sgt. D. H. Stoneham; Flt. Lt. B. E. Stourton; Flt. Sgt. L. M. Talbot; Sgt. W. E. J. Topping; F/O. A. E. Vidler; Flt. Sgt. E. G. Walker; Sgt. T. Warden; Sgt. W. A. F. Watson; Sgt. H. B. West; Sgt. G. R. Wheaton; F/O. R. L. White; Sgt. H. F. Willcocks.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Flt. Sgt. T. Jones.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. D. F. Barnard; Flt. Sgt. A. D. Brand; Flt. Lt. E. J. Bull; Sgt. A. K. Butcher; F/O. C. J. Cheverton; Sgt. J. Cooper; P/O. R. C. Cross; F/O. B. H. Dennis; Flt. Sgt. J. K. Goslin; Sgt. H. Hallwell; Sgt. J. Harrison; Sgt. A. A. Hatton; Sgt. J. G. D. Hislop; Sgt. R. Matthews; Sgt. V. J. Mayo; F/O. R. O'Neill; Sgt M. C. Pocock; F/O. S. Pugh; Sgt. R. I. Pym; F/O. J. F. Stein; F/O. R. G. Ward; Sgt. A. Whitehead.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. W. Shepherd; L.A/C. J. Smith; Sgt. F. G. Wells.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Act. Sgt. W. Adamson; Act. Sgt. G. F. Edwards; Sgt. D. E. Griffiths; Sgt. E. Middleton; Sgt. D. Smith; Wing Cdr. A. W. T. Traill, D.F.C.

WOUNDED OR INJURED ON ACTIVE SERVICE.—W/O. R. Rogers; Sgt. J. Rosenthal.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Lt. J. A. Hawkins; Act. Sqn. Ldr. T. G. Westlake.

DIED ON ACTIVE SERVICE.—L.A/C. W. Bird; Flt. Sgt. H. Boardman; Flt. Sgt. P. L. Browning; A/C.2 R. P. Carbines; Cpl. G. T. Coombes; A/C.2 J. Fitzgerald; A/C 2 W. Foxe; Sgt. T. J. Goodwin; A/C.1 S. R. Hamblin; A/C.2 W. H. Hamer; Cpl. D. A. Hart; A/C.1 G. A. Ince; Sgt. W. B. Jamieson; L.A/C. R. A. G. Lee; L.A/C. W. McGill; Sgt. W. McMaster; A/C.1 W. D. Middleton; Act. Sqn. Ldr. H. Morris; L.A/C. N. Naylor; L.A/C. B. E. Newell; Flt. Sgt. S. R. Pascoe; L.A/C. A. Rodrigues; L.A/C. J. W. Royston; Cpl. W. E. Summerfield; L.A/C. E. Tasker; L.A/C. J. Turnbull.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sqn. Ldr. M. J. Baird-Smith, D.F.C.; Sgt. E. F. Bartholomew; Sgt. J. T. Causier; Sgt. J. V. P. Daly; Sgt. A. H. Squallman; F/O. F. O. Waddington, D.F.M.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.1 G. Davies; A/CW.2 D. R. Dawson; L.A/CW. D. A. Evans; L.A/CW. H. M. Phillipson; Sgt. N. E. Sherlock; Cpl. J. W. Stevenson.

GETTING THE "GEN": F.A.A. crews being briefed by Lt. Cdr. (A) J. M. Ghaser in the air operations room of H.M.S. *Fencer*.

Royal Australian Air Force

KILLED IN ACTION.—Flt. Sgt. E. N. Emberson; Flt. Sgt. F. W. Gissing; Flt. Sgt. A. J. Huntley; F/O. H. R. McMillan.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. G. V. Courtney.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. S. V. Brown; Flt. Sgt. J. A. Chappell; Act. Flt. Lt. H. K. Hornibrook; Sgt. J. Lynch; Flt. Sgt. G. A. G. McLeod; P/O. H. G. Norton.

WOUNDED OR INJURED IN ACTION.—W/O. H. G. Clarke.

MISSING, BELIEVED KILLED IN ACTION.—W/O. D. A. Anderson; P/O. R. W. Burke; Flt. Sgt. M. T. Knox; F/O. B. F. Lawler; W/O. A. E. McGee.

MISSING.—Flt. Sgt. J. Bernaldo; Flt. Sgt. W. G. Boyce; P/O. T. W. Bradley; Flt. Sgt. J. L. Brooks; Flt. Sgt. J. E. Brown; F/O. J. W. K. Cameron; Flt. Sgt. M. H. Cutmore; Act. Flt. Lt. G. McG. Doolan; P/O. S. A. Edmonds; Flt. Sgt. S. G. Emery; P/O. K. G. Feeney; P/O. J. Finch; Flt. Sgt. P. S. Fleming; Flt. Sgt. M. G. Francis; P/O. A. Henry; Flt. Sgt. J. S. Hosier; F/O. A. J. D. Levy; Flt. Sgt. D. H. Martin; P/O. J. A. H. Nimmo; Flt. Sgt. E. Oberhardt; P/O. F. H. O'Neill; P/O. R. J. Proud; Flt. Sgt. L. A. Rands; F/O. L. M. Ryan; P/O. A. T. Thornton; Flt. Sgt. S. A. Wilson.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. P. H. Brown; P/O. B. L. Humphreys; W/O. F. A. Ormiston.

DIED ON ACTIVE SERVICE.—Flt. Sgt. J. T. Geoghegan.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Flt. Sgt. T. L. Fielder.

Royal Canadian Air Force

KILLED IN ACTION.—P/O. N. Bridges; F/O. C. C. Drew, A.F.C.; F/O. S. L. Huntley; F/O. M. S. Little.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. F. A. Campbell; Flt. Sgt. V. T. Perdue.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. L. M. Banks; P/O. R. E. Currie; Flt. Sgt. T. B. Liffman; Flt. Sgt. M. B. Murphy; Flt. Sgt. W. B. Ness; Flt. J. F. Sheridan; P/O. T. A. T. Williams.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—F/O. A. F. G. Hughes.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Lt. A. G. Dickie; Sgt. C. M. Fugere; Sgt. L. C. Glasser; Sgt. J. V. Roberts.

MISSING.—Flt. Sgt. J. E. Allen; Flt. Lt. K. E. Cullen; F/O. W. D. M. Devine; Sgt. G. R. Dunn; Sgt. A. Grosutti; P/O. J. T. Hemsworth; Flt. Lt. C. D. T. Holmberg; F/O. A. MacK. Howden; Flt. Sgt. L. A. R. Lowe; W/O. J. M. McCallum; F/O. A. C. McLeod; F/O. R. W. Murray; P/O. J. S. Owens; Sgt. J. P. Papineau; P/O. J. W. Patrick; W/O. H. E. Quinn; Flt. Lt. V. T. Robinson.

KILLED ON ACTIVE SERVICE.—Sgt. W. A. Andrews; Sgt. D. G. Bell; Flt. Sgt. A. K. Clarke; Sgt. F. E. Cranch; F/O. H. G. Eise; Sgt. F. C. Hindmarsh; F/O. R. W. Honderich; P/O. D. E. C. Lawrence; F/O. J. D. C. Leferbvre; L.A/C. D. V. MacKenzie; F/O. T. Sandberg; F/O. G. E. Vance; W/O. T. H. Woodard.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. A. Quann.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. A. C. Starnes.

DIED ON ACTIVE SERVICE.—L.A/C. F. G. Westcott.

Royal New Zealand Air Force

KILLED IN ACTION.—Flt. Lt. R. G. Mellsop.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. F. S. Edgar.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. L. F. English; F/O. B. L. Jackson; Flt. Sgt. E. O'Shaughnessy; F/O. E. I. Smallfield.

MISSING.—Act. Sqn. Ldr. A. H. Green.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. W. M. Aitken; Flt. Sgt. D. H. Delaney; Flt. Sgt. J. Gold; Flt. Sgt. G. R. Weston.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. H. Frew.

South African Air Force

KILLED IN ACTION.—Lt. Cronin; Lt. De McNab; 2/Lt. L. B. Fillish; Lt. Lawrence; Lt. I. J. V. Prowe; 2/Lt. W. R. Scodt.

MISSING.—2/Lt. W. R. Barrett; Lt. J. E. Brant; Lt. F. G. Hamilton.

KILLED ON ACTIVE SERVICE.—Lt. Blanckenberg; 2/Lt. C. H. Constantin; Lt. H. Hamm; 2/Lt. Watkins.

Official Correction

Casualty Communiqué No. 398.

R.A.A.F., under "DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE," it is regretted that Flt. Sgt. R. M. Morton was erroneously placed under this heading. His name should have appeared under "WOUNDED OR INJURED ON ACTIVE SERVICE."

Air Transport Auxiliary

First Officer WILBUR WASHINGTON (BEE) ACTON, U.S.A., A.T.A., killed in the course of ferrying duties in England.

1944

aser

owden;
Callum;
; P/O.
J. W.
V. T.

A. An-
Clarke;
F. C.
D. E. C.
D. V.
Vance;

VICE.—

ED ON

West

orce

sop.
IEVED
ED IN

PRE-
L. F.
t. E.

W. M.
gt. J.

VICE.—

cNab;
J. V.

Brant;

berg;
2/Lt.

a IN-
is re-
erro-
name
R IN-

ry
(BEE)
se of